U.S. Fish & Wildlife Service

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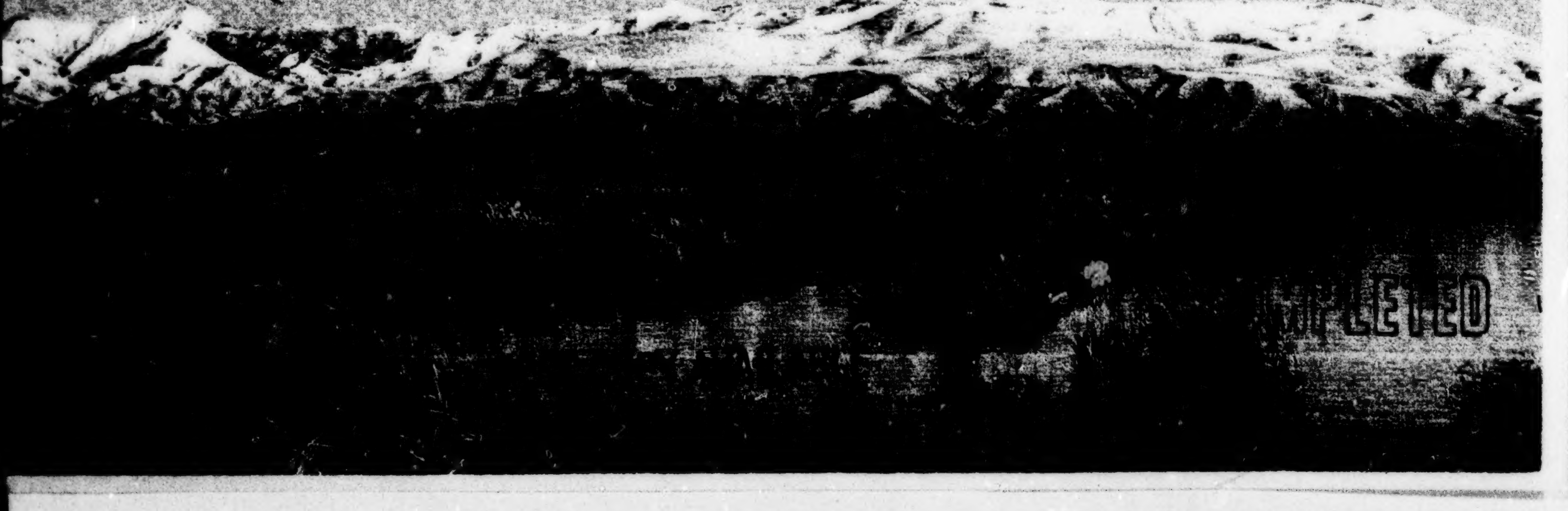
Stillwater National Wildlife Refuge Complex

Draft Environmental Impact Statement for the Comprehensive Conservation Plan and Boundary Revision

Volume 1

2002-005996/NF



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Draft Environmental Impact Statement
for the
STILLWATER NATIONAL WILDLIFE REFUGE COMPLEX
COMPREHENSIVE CONSERVATION PLAN and
BOUNDARY REVISION
Churchill and Washoe Counties, Nevada

Type of Action:	Administrative
Lead Agency:	U.S. Department of the Interior, Fish and Wildlife Service
Responsible Officials:	Anne Badgley, Regional Director, Region 1 Michael Spear, California/Nevada Operations Manager
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Abstract: This draft environmental impact statement (Draft EIS) describes and evaluates four alternative comprehensive conservation plans and boundary scenarios for the Stillwater National Wildlife Refuge (NWR) Complex, which is comprised of Stillwater NWR, Fallon NWR, Stillwater Wildlife Management Area, and Anaho Island NWR. The No Action Alternative (Alternative A) would retain the existing boundaries and entails baseline management as outlined in the 1987 Management Plan for Stillwater WMA and modified by the U.S. Fish and Wildlife Service's (Service's) water-rights acquisition program. Alternative B would result in the lands within Stillwater WMA reverting back to U.S. Bureau of Reclamation or public land status, and would focus on providing fall and winter habitat for waterfowl and opportunities for waterfowl hunting on Stillwater NWR and breeding habitat for waterbirds on Fallon NWR. Under Alternative C (Service's Preferred Alternative), Stillwater NWR would be expanded to include most of Stillwater WMA and Fallon NWR and to include additional riparian and dune habitat. This alternative would emphasize the approximation of natural biological diversity, with adjustments to enhance breeding habitat for waterbirds and fall and winter habitat for waterfowl, and would provide enhanced opportunities for wildlife observation and environmental education. Alternative D, in which Stillwater NWR would be expanded to include all of Stillwater WMA and Fallon NWR and to include additional riparian and dune habitat, would focus on restoring natural hydrologic patterns and other ecological processes. Public use management would focus on providing opportunities for wildlife observation and environmental education. In all alternatives, Anaho Island NWR would be managed much as it has in the past, with a continued emphasis on protecting the nesting colony of American white pelicans and other colony-nesting birds that use the island.

The issues addressed in this Draft EIS include the potential effects of the alternatives on populations of fish, wildlife, plants, and their habitat; priority public uses of the National Wildlife Refuge System; other public uses; cultural resources; Newlands Irrigation Project Operations; Naval Air Station-Fallon training; and the local economy. An insufficient volume of water inflow, nonnative species (including livestock), and contaminants are the major factors limiting achievement of refuge purposes of Stillwater NWR and Fallon NWR. Compatibility of public uses is also a major issue addressed in this Draft EIS.

Commenting: Reviewers should provide the Service with their comments during the review period of this Draft EIS. This will enable the Service to analyze and respond to the comments at one time and to use this input in the preparation of the final impact statement and the comprehensive conservation plan, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their input so that it is meaningful and alerts the agency to the reviewer's position and contentions. Environmental objections that could have been raised at the draft stage may be waived if not raised until after the completion of the final environmental impact statement. Comments on the Draft EIS should be specific and should address the adequacy of the EIS and the merits of the alternatives discussed (40 CFR 1503.3).

All comments received from the public will be placed in the Service's record for this action. As part of the record, comments will be made available for inspection by the general public, and copies may also be provided to the public. For persons who do not wish to have their names and other identifying information made available, anonymous comments will be accepted.

Comments on this Draft EIS should be mailed to Stillwater NWR **no later than June 12, 2000**

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

for the

STILLWATER NATIONAL WILDLIFE REFUGE COMPLEX

COMPREHENSIVE CONSERVATION PLAN and BOUNDARY REVISION

March 2000

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This draft environmental impact statement was developed consistent with requirements of the National Environmental Policy Act (42 U.S.C. 4321 et seq.)

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Reader's Guide

Management of all national wildlife refuges, which are administered by the U.S. Fish and Wildlife Service, consists of a repeating process of planning, implementation, and monitoring and adjusting. The planning process generally involves three levels of planning: (1) the development of a broad comprehensive conservation plan, (2) the formulation of detailed step-down management plans, and (3) annual work plans and site-specific projects. This planning process focused on the first of these, but also involved the development of step-down management plans. In addition, the boundary of Stillwater National Wildlife Refuge (NWR) was assessed for possible revision as part of this planning effort.

Public involvement and National Environmental Policy Act (NEPA) compliance are continued at all appropriate levels of planning prior to implementation of major actions. This draft environmental impact statement (Draft EIS) provides NEPA compliance for a comprehensive conservation plan, a revision of the boundary of Stillwater NWR, and several step-down management plans.

The Draft Environmental Impact Statement (Volume I)

Chapter 1, *Introduction*, has three main parts: (1) purpose and need for action, (2) background information on the Stillwater NWR and related actions, and (3) major issues identified during scoping and a summary of the public involvement process.

Chapter 2, *Summary of the Affected Environment*, provides an introduction to the EIS study area. This chapter only provides a summary of resource conditions, with more detailed descriptions of existing and baseline conditions being covered in Chapter 4. Chapter 2 describes (1) the international, national, regional, and landscape context of planning and management; (2) geographic and socioeconomic setting of the EIS Study area; and (3) a brief summary of Stillwater NWR Complex resources. Because of the importance of natural habitat conditions to the decision to be made, a description of these conditions is provided at the end of Chapter 2.

Chapter 3, *Alternatives*, starts out with a description of the laws, Federal policy, international treaties and agreements, Service plans, and issues that guided the development of the alternatives. Each alternative in this Draft EIS consists of a boundary-revision option for Stillwater NWR, goals for managing each refuge in the complex, objectives to achieve these goals, strategies to accomplish objectives, and a monitoring program to track progress in implementing strategies and achieving objectives and goals.

Chapter 4, *Environmental Consequences*, describes the existing and baseline environmental resources of the EIS study area and identifies and provides an evaluation of the potential environmental impacts of the alternatives, described in Chapter 3, on these resources.

Volume II of the Draft EIS contains technical appendices and other supportive material.

Contents of the Comprehensive Conservation Plan

Many of the components contained in this Draft EIS will eventually comprise the comprehensive conservation plans that will be developed for the refuges in the Stillwater NWR Complex. A comprehensive conservation plan is a document that describes the desired future conditions of the refuge and provides long-range guidance and management direction to accomplish the purposes of the refuge, contribute to the mission of the System, and meet other relevant mandates. It outlines the management approach that will guide management of the refuge. In large part, a comprehensive conservation plan provides direction and guidance on how wildlife and their habitat will be managed, and how compatible wildlife-dependent recreational uses will be promoted and facilitated. It identifies the appropriate uses that can occur on the refuge and how these uses will be managed to ensure that they are compatible with wildlife conservation as outlined in refuge purposes and the mission of the National Wildlife Refuge System.

The four different alternatives outlined in this Draft EIS represent different comprehensive conservation plans. The alternative that is eventually be selected for implementation will provide the framework of the refuge complex's comprehensive conservation plan; it will provide the refuge goals, objectives, and strategies, which is the heart of a comprehensive conservation plan. The plan will only contain goals, objectives, and strategies from one of the four alternatives considered in this Draft EIS. Another large section of the comprehensive conservation plan will be a description of existing and natural ecological conditions, and the existing status of the public-use program. Discussions on existing and natural conditions that will be incorporated into the final plan are summarized in Chapter 2 of this Draft EIS and detailed in Chapter 4 under each resource heading. Background information will also be presented in the plan, including a discussion of the significant problems affecting populations and habitats of wildlife and their habitat (presented in Chapter 1 of this Draft EIS), a summary of the refuge's history and legal mandates (presented in Chapters 1 and 3), and of the planning process (presented in Chapter 1). Additional information will include a list and brief description of action items to be carried out in first few years of implementation. Alternatives not selected (remainder of Chapter 3) and the evaluation of impacts (Chapter 4) will not be repeated in the comprehensive conservation plan.

Separate comprehensive conservation plans will be developed for each refuge in the complex, rather than incorporating the various goals, objectives, and strategies of all refuges into one document. Some of the objectives and strategies for Stillwater NWR in the alternatives are somewhat detailed, especially with respect to water management. Rather than incorporating all of this detail into the comprehensive conservation plan itself, much of the detail will be written into accompanying step-down management plans (e.g., a water management plan). This would limit the comprehensive conservation plan to broad-level management direction and guidance.

Step-down Management Plans

This Draft EIS contains the environmental analysis (NEPA documentation) not only for the comprehensive conservation plans, but also the following step-down plans that will accompany the comprehensive conservation plans:

- habitat management plan
- water management plan
- fire management plan
- saltcedar control plan
- public use plan

Adaptive Management

A high level of interest was expressed during scoping that the comprehensive conservation plan for Stillwater NWR Complex be flexible and that it allow for changes to be made based on information obtained through monitoring. This will be an important part of a comprehensive conservation plan. A comprehensive monitoring program and mechanisms for making adjustments to the management actions, strategies, and objectives will be integrated into the plan. Each alternative described in this Draft EIS includes the framework of such a program. For each alternative, the objectives and strategies that could be adjusted over time with additional information are identified, as well as the features of the alternative that will remain unchanged through the life of the plan. Successful implementation of a comprehensive conservation plan requires that managers be permitted to make adjustments to objectives and strategies. It also requires that the target of management, as expressed in refuge purposes, goals, and subgoals, remain the same through the life of the plan.

The goals, subgoals, and guiding principles selected for implementation for the Stillwater NWR Complex will be adopted for the life of the plan (15 years or more). They can be revisited, but alterations to the goals and subgoals, beyond editorial changes, would require the Service to go through the comprehensive conservation planning process to make these changes. To successfully attain the goals and subgoals identified in the comprehensive conservation plan, adjustments may be needed in specific objectives and strategies.

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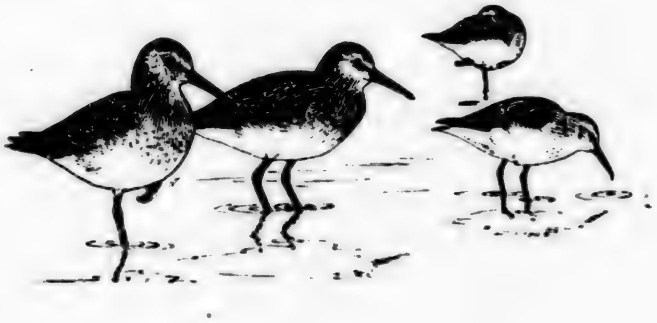

CHAPTER 1
INTRODUCTION

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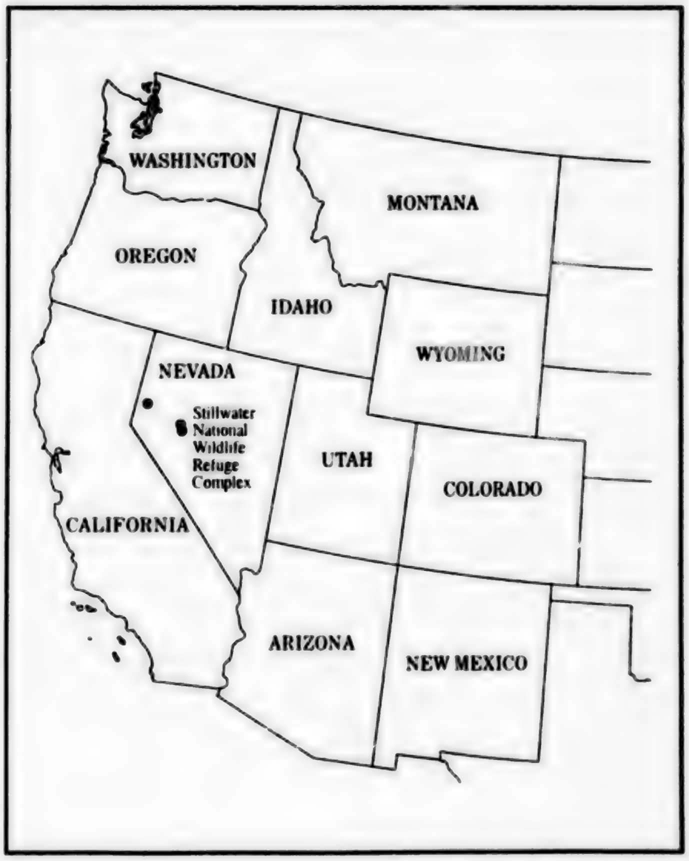
CHAPTER 1
INTRODUCTION

1.1 PART ONE - PURPOSE AND NEED

1.1.1 INTRODUCTION

The Service began the process of developing a comprehensive conservation plan for the Stillwater National Wildlife Refuge (NWR) Complex in early 1997. This Draft Environmental (EIS) identifies and provides an evaluation of four alternative approaches for managing the Stillwater NWR Complex for the next 15 years. Each alternative consists of two main parts: (1) a boundary revision for Stillwater NWR, and (2) the framework of a potential comprehensive conservation plan, including refuge goals, objectives, and strategies for achieving the purposes for which each refuge was established and for contributing toward the mission of the National Wildlife Refuge System (Refuge System). The Stillwater NWR Complex currently includes Stillwater NWR, Stillwater Wildlife Management Area (WMA), Fallon NWR, and Anaho Island NWR, which are located in west-central Nevada (Maps 1.1 and 1.2).

Together, these refuges and the wildlife management area contribute substantially to the conservation of wildlife and their habitat in the western Great Basin. They encompass a great diversity of habitats, from freshwater marshes and river habitats to brackish-water marshes and alkali playas, and extensive saltdesert shrublands and a 25-mile long sand dune complex to a small island in a desert lake. These habitats attract nearly 400 species of vertebrate wildlife (more than 260 bird species) and countless species of invertebrates. Waterfowl, shorebirds, and other waterbirds are abundant, especially during migration.



This immense richness and abundance of wildlife and habitats in a desert environment provides a striking setting for hunting, observing, and learning about wildlife in the Great Basin. Waterfowl hunting has a long history at Stillwater Marsh and this tradition will continue. In recent years, birdwatching and environmental education have been growing in popularity. In addition to obtaining immense enjoyment from Stillwater NWR's wildlife and habitats, individuals partaking in these activities have been instrumental in ensuring the long-term viability of the wetlands on Stillwater NWR. If it were not for the efforts of several Nevada-based conservation groups, it is likely that the Service would not be acquiring much needed water rights for the refuge's wetlands.

The human association with Stillwater Marsh goes back at least 12,000 years. The culture and traditions of the Cattail-eater Northern Paiutes, or *Toedokado*, is embodied in the area's cultural resources. Because Stillwater Marsh was such an ideal place for humans to live over the millennia, Stillwater NWR contains some of the richest cultural resources in the Great Basin.

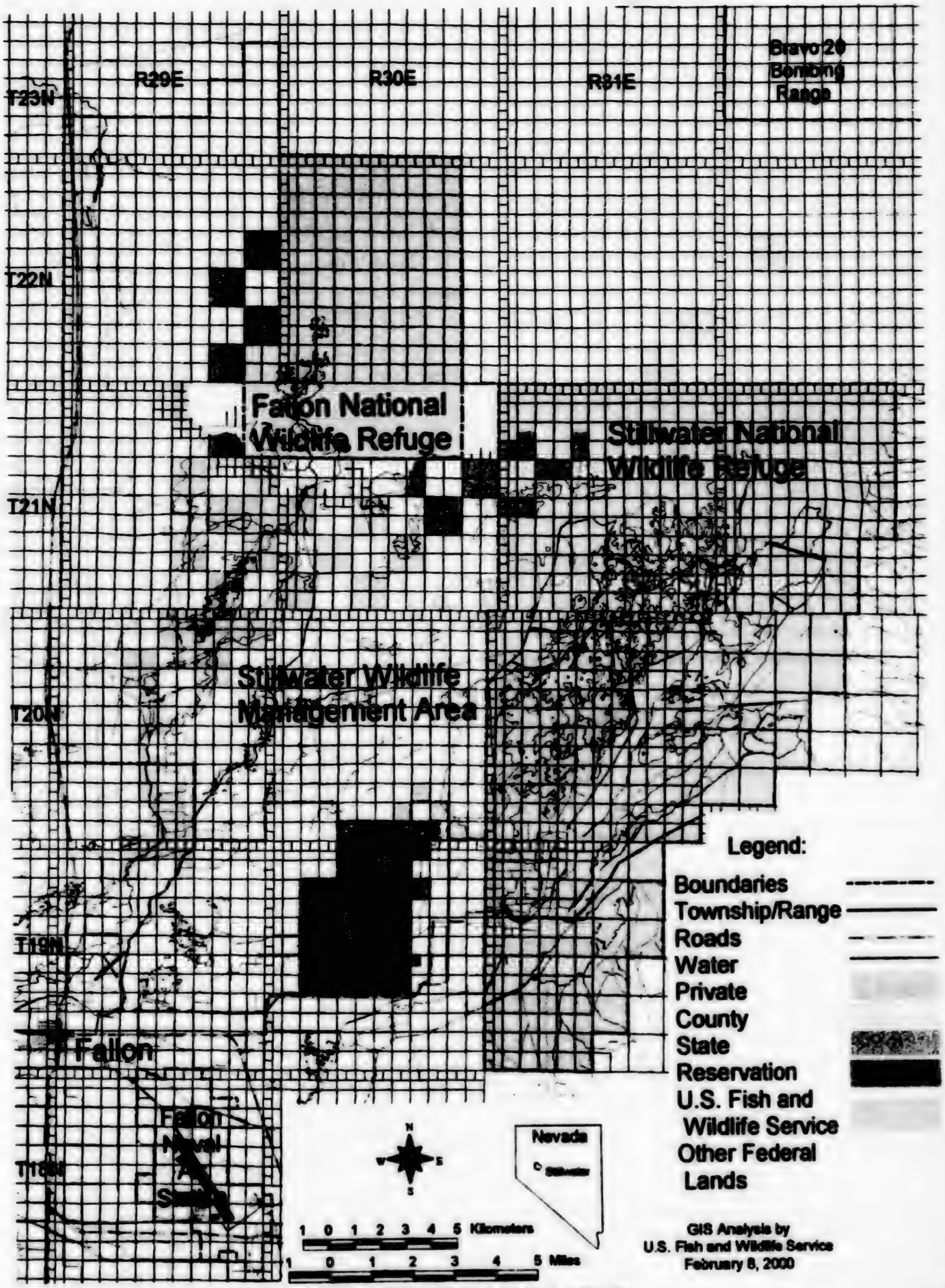
The contiguous Stillwater NWR, Stillwater WMA, and Fallon NWR are located about 6 miles northeast of Fallon, Churchill County (Map 1.3). Stillwater NWR contains about 79,570 acres of Federal land, Stillwater WMA about 65,600 acres, and Fallon NWR about 17,850 acres, for a combined total of 163,020 acres of Federal land. Non-Federal inholdings within the approved boundaries make up about 59,710 acres (Map 1.4).

Anaho Island NWR is in the Pyramid Lake Indian Reservation and is about 30 miles northeast of Reno, Washoe County. The Paiute name for Anaho Island is "Pai-sa-ka-tu-du" which means roughly "... the dry island sitting out there all by itself..." The refuge encompasses the entire island, which has fluctuated in size from 220 to 745 acres in recent history due to the fluctuating water levels of Pyramid Lake. In the summer of 1997, the island was approximately 575 acres, and in the summer of 1999 it was down to 490 acres as the water level of Pyramid Lake continued to rise.

1.1.2 PROPOSED ACTION

The proposed action is to (1) identify a boundary configuration of Stillwater NWR that would best facilitate the achievement of the purposes for which the refuge was established, and (2) develop a comprehensive conservation plan for the Stillwater NWR Complex that best achieves the purposes of the individual refuges that make up the complex, contributes to the mission of the Refuge System, is consistent with the principles of sound fish and wildlife management, and that addresses relevant mandates and the major issues identified during scoping. Any expansion of the approved boundary of Stillwater NWR would allow the Service to negotiate with willing participants within this boundary to acquire land. Lands acquired by the Service would be managed as part of the Refuge System.

Map 1.4 Land Ownership



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1.1.3 PURPOSE OF AND NEED FOR ACTION

The purpose of developing a comprehensive conservation plan for the Stillwater NWR Complex is to provide managers with a 15-year strategy for achieving refuge purposes and contributing toward the mission of the Refuge System, consistent with sound principles of fish and wildlife conservation and legal mandates. The purpose of revising the boundary of Stillwater NWR is to help the Service achieve the purposes of the refuge.

A comprehensive conservation plan, required by the National Wildlife Refuge System Administration Act of 1966, as amended (Refuge System Administration Act), is needed because (1) Stillwater NWR does not have a management plan that provides direction for managing wildlife, habitat, and public uses on the refuge under the management direction established by the Truckee-Carson-Pyramid Lake Water Settlement Act of 1990 (Title II of Public Law 101-618) and the increased volume of water to be delivered to the refuge, as authorized by the Public Law; (2) Fallon NWR does not have a management plan for managing wildlife, habitat, and public uses on the refuge under the management direction established by Executive Order 5606 in 1931; and (3) Anaho Island does not have a management plan. Compatibility determinations have not been completed for any of the public uses occurring on Stillwater NWR and Fallon NWR. Thus, a comprehensive conservation plan is needed to resolve several issues with respect to wildlife and public-use management on the Stillwater NWR Complex, including water management priorities, control of noxious weeds, livestock grazing, and managing wildlife-dependent recreational activities.

A **compatible use** is a public use of a refuge that, in the sound professional judgement of the Refuge Manager, will not interfere with or detract from the ability to fulfill refuge purposes and the mission of the Refuge System. A **compatibility determination** is a document signed by the Refuge Manager signifying that a proposed or existing use is either compatible or not compatible.

1.1.4 DECISIONS TO BE MADE AND CRITERIA FOR DECISION-MAKING

1.1.4.1 Boundary Revision

The Pacific Regional Director of the U.S. Fish and Wildlife Service will decide which boundary-revision alternative best meets the criteria described below. This decision will be made in full recognition of the environmental effects of each alternative. The decision will be designated in a Record of Decision (ROD) document no sooner than 30 days after the final EIS is filed with the Environmental Protection Agency (EPA) and distributed to the public. The selected boundary-revision alternative will then be submitted to the U.S. Congress as the Service's recommended boundary revision for Stillwater NWR.

Subsection 206(b)(5) of Public Law 101-618 specifies two sets of criteria upon which to base any revisions of Stillwater NWR's boundary: (1) the extent to which a boundary revision would facilitate the Service's ability to carry out the purposes of Stillwater NWR, and (2) the extent to which a boundary revision would facilitate efforts to carry out provisions of subsection of 206(a) of the Public Law (i.e., sustaining a long-term average of 25,000 acres of primary wetland-habitat in the Lahontan Valley). These criteria are discussed in more detail in Chapter 2.

1.1.4.2 Comprehensive Conservation Plan

The decision to be made by the California/Nevada Operations Manager (Pacific Region, U.S. Fish and Wildlife Service) with respect to the comprehensive conservation plan is the selection of an alternative to implement as the Stillwater NWR Complex Comprehensive Conservation Plan. This decision will be made with an understanding of the environmental consequences of all alternatives considered. The decision will be documented in a ROD no sooner than 30 days after the final EIS is filed with the EPA and distributed to the public. Implementation of the plan will begin immediately upon publishing a summary of the ROD in the *Federal Register*.

The following criteria will be used in selecting the alternative for implementation. Of primary consideration will be the alternative that would best facilitate the conservation of fish, wildlife, plants, and their habitat according to refuge purposes. The Refuge System Administration Act established that the fundamental mission of the Refuge System is the conservation of fish, wildlife, and plants (this is the top priority of all refuges). Subsections 206(b)(2) and 210(b)(2) of Public Law 101-618, and Executive Orders 5606 and 1819 direct that Stillwater NWR, Fallon NWR, and Anaho Island NWR, respectively, be managed for specific purposes. Given the importance of Stillwater NWR to wetland-dependent wildlife, as specified in Public Law 101-618, benefits to wetland-dependent wildlife (especially migratory birds) will be an important criteria, especially in the context of a natural diversity of this group of wildlife. The alternative that would contribute most to restoring the biological integrity and the environmental health of the ecological system within refuge borders will also be of high consideration.

Another important criterion in identifying the best alternative for implementation is the degree to which public-use management requirements are met. Public Law 101-618 directs that Stillwater NWR be managed to "provide opportunities for scientific research, environmental education, and wildlife-oriented recreation," and the Refuge System Administration Act directs the Service to facilitate opportunities for hunting, fishing, wildlife observation and photography, and environmental education and interpretation (wildlife-dependent recreational uses) in the Refuge System, to the extent they are compatible with refuge purposes and the mission of the Refuge System. The Act also emphasizes providing opportunities for families to experience compatible wildlife-dependent recreation, particularly opportunities for parents and their children to safely engage in traditional outdoor activities such as hunting and fishing. Heavy consideration will be given to alternatives that balance opportunities for compatible wildlife-dependent recreation.

In summary, the selection of an alternative for implementation will be based primarily on the extent to which it would meet the following criteria, listed in priority order, as compared to the other alternatives:

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1. Conservation of:
   a. fish, wildlife, plants, and their habitat, with an emphasis on a natural diversity of these components (for Stillwater NWR);
   b. breeding habitat and sanctuary (for Fallon NWR); and
   c. colonial-nesting species (for Anaho Island NWR);

2. Conservation of:
   a. wetland-dependent wildlife (for Stillwater NWR); and
   b. a natural diversity of wildlife and plants (for Anaho Island and Fallon NWRs);

3. Provide opportunities for wildlife-dependent recreational uses that are compatible with refuge purposes and balanced among uses (for Stillwater NWR);

4. Provide opportunities for other appropriate and compatible uses.

1.2 PART TWO - BACKGROUND

1.2.1 ESTABLISHMENT AND HISTORY OF THE STILLWATER NWR COMPLEX

Anaho Island NWR was established in 1913 by Executive Order 1819 as a " . . . preserve and breeding ground for native birds." Public Law 101-618 (§210(b)(2)) more narrowly defined the purpose of Anaho Island NWR, stating that it was to be managed and administered " . . . for the benefit and protection of colonial-nesting species and other migratory birds." The Public Law also recognized that Anaho Island is part of the Pyramid Lake Indian Reservation, but it is to be managed and administered by the Service as a component of the Refuge System. A memorandum of understanding between the Service and the Pyramid Lake Paiute Tribe was signed in March 1992 that outlined the terms of the Service's management and administration of the island.

Fallon NWR contains about 17,850 acres of Federal land and was established in 1931 by Executive Order 5606 "as a refuge and breeding ground for birds and other wild animals." It has been managed as part of the Stillwater WMA.

Stillwater WMA and Stillwater NWR were established through a 50-year agreement (1948 Tripartitie Agreement) signed in 1948 by the Truckee-Carson Irrigation District (TCID), Nevada State Board of Fish and Game Commissioners (Nevada Division of Wildlife), and the Service. Although the agreement expired in November 1998, the Service continues to cooperatively manage the Stillwater WMA with the Bureau of Reclamation under most provisions of the 1948 Tripartite Agreement (USBOR 2000). When Stillwater WMA was established, it encompassed

2L

about 200,000 acres of land, of which about 140,000 acres were Public Land that was originally withdrawn by the Bureau of Reclamation for Newlands Irrigation Project purposes. Stillwater WMA was established in 1948 for the purposes of conserving and managing wildlife and their habitat, and for public hunting. Under the Tripartite Agreement, livestock grazing and muskrat production were to be managed commensurate with wildlife conservation and management. Adjacent to the public hunting area located in Stillwater WMA, Stillwater NWR was established in 1949 as a wildlife sanctuary (closed to hunting). It encompassed about 24,200 acres of Federal land, and consisted of the areas south of Division Road and east of Hunter Road (Map 1.3).

In 1990, the approved boundary of Stillwater NWR was expanded, under subsection 206(b)(1) of the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Title II of Public Law 101-618), to encompass Stillwater Marsh, most of which was previously in the Stillwater WMA. Map 1.4 identifies the existing boundary of Stillwater NWR. In addition to the boundary expansion, Public Law 101-618 also outlined four purposes for which the Service must manage Stillwater NWR: (1) maintaining and restoring natural biological diversity within the refuge; (2) providing for the conservation and management of fish and wildlife and their habitats within the refuge; (3) fulfilling international treaty obligations of the United States with respect to fish and wildlife; and (4) providing opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation.

The **natural biological diversity** of the Stillwater area refers to the variety within and among biological communities that evolved in the area under geological, evolutionary, and other ecological processes.

Enactment of Public Law 101-618 shifted the legal authority for managing the lands now within Stillwater NWR from the Tripartite Agreement to the Refuge Administration Act and the refuge purposes identified in the public law. Four of the most marked changes in legal directives are as follows. The Public Law enacted a shift in priorities whereby wildlife conservation became the single highest priority. It directed that all wildlife-dependent public uses be given equal emphasis in planning and management, that these priority public uses be given higher consideration than all other public uses, and that all uses must be shown to be compatible with refuge purposes before they can be allowed to occur on the refuge. Livestock grazing and muskrat trapping are only to be permitted to the extent they can help in achieving refuge purposes. The Public Law also mandated that the Service make recommendations to Congress on any boundary revisions that may be needed to help carry out refuge purposes and other provisions of the law.

1.2.2 Related Actions under Public Law 101-618

Related actions under Public Law 101-618 are described in the *Final Environmental Impact Statement* for *Water Rights Acquisition for Lahontan Valley Wetlands* (USFWS 1996:1-18 - 1-29). Related actions under Public Law 101-618 include:

- Acquisition and use of land and water rights for the Fallon Tribe (sec. 103);
- Closure/modification of TJ Drain (sec. 106);
- Truckee River Operating Agreement (sec. 205);
- Lahontan Valley wetlands water-rights acquisition program (subsec. 206(a));
- Naval Air Station-Fallon water conservation (subsec 206(c));
- State of Nevada cost-sharing (subsec. 206(d));
- Transfer of Carson Lake (subsec. 206(e));
- Transfer of the Indian Lakes area (subsec. 206(g));
- Recovery actions for endangered and threatened Pyramid Lake fish (sec. 207); and
- Newlands Project Operating Criteria and Procedures (OCAP), Project Efficiency, and Recoupment (sec 209).

Subsection 206(a) of Public Law 101-618 directs the Secretary of the Interior to acquire enough water and water rights, in conjunction with the State of Nevada and other parties, to sustain a long-term average of 25,000 acres of primary wetland-habitat in the Lahontan Valley. The *Final Environmental Impact Statement for Water Rights Acquisition for Lahontan Valley Wetlands* (Water-rights Acquisition EIS) describes a water-rights acquisition program that was implemented by the Service in November 1996 when the record of decision was signed for the EIS. The EIS estimated that 125,000 acre-feet of water would be needed to sustain 25,000 acres of wetland-habitat. Key elements of the selected alternative include the continued use of irrigation drainwater and periodic excess water released from Lahontan Reservoir, acquisition of 75,000 acre-feet of water rights in the Carson Division of the Newlands Irrigation Project, acquisition of water rights from the middle Carson River, leased water rights in the Carson Division, water conserved at the Naval Air Station-Fallon, and groundwater pumping. Together, these sources of water are anticipated to provide a long-term average of 125,000 acre-feet of water for the wetlands.

Of the 25,000-acre target, about 14,000 acres of wetland-habitat would be sustained over the long term on Stillwater NWR. Another 10,200 acres would be sustained on Carson Lake Wildlife Management Area, and the remaining 800 acres would be sustained on the Fallon Paiute-Shoshone Indian Reservation. Among other things, this draft comprehensive conservation plan outlines the objectives and strategies for managing the 14,000 acres of wetland-habitat on Stillwater NWR.

1.3 PART THREE - ISSUES AND PUBLIC INVOLVEMENT

The Service began the development of a comprehensive conservation plan for Stillwater NWR Complex and an evaluation of Stillwater NWR's boundary for possible revision in early 1997. In the process of developing alternatives for the plan and boundary revision, the Service involved the public, including other agencies, in a variety of ways. This part of Chapter 1 summarizes the public involvement activities and other consultation and coordination activities (1.3.1) and major

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issues identified through scoping (1.3.2), including significant problems adversely affecting fish, wildlife, and plant populations and their habitat.

1.3.1 SUMMARY OF PUBLIC INVOLVEMENT AND OTHER COORDINATION AND CONSULTATION

1.3.1.1 GENERAL MEETINGS AND OUTREACH

1.3.1.1.1 Initial Scoping Meetings and Open-house Workshops

Three public scoping meetings were conducted in early 1997 by the Department of the Interior for several potential Federal actions, including comprehensive conservation planning at the Stillwater NWR Complex. The meetings, conducted in Fallon (March 11), Fernley (March 12), and Reno (March 19), Nevada, addressed four Federal actions: (1) Stillwater NWR Complex comprehensive conservation planning, including a potential boundary revision, (2) potential modification to OCAP for the Newlands Project, (3) water acquisitions for cui-ui recovery, and (4) the Truckee River Water Quality Settlement Agreement. Few comments were received on Stillwater NWR Complex issues during these meetings. A Notice of Intent to prepare an EIS was published in the *Federal Register* on March 14, 1997 (Volume 62, Number 50, pages 12245-12246) by the Department of the Interior.

The Service subsequently conducted open-house workshops in Fallon on March 24, April 30, and July 17, 1997 and in Reno on March 25, April 29, and July 16, 1997. These open-houses were conducted specifically to gather additional input on major issues, potential courses of action, possible impacts and mitigation for the Service to consider during the evaluation of the existing Stillwater NWR boundary and during the development of goals, objectives, and strategies for the comprehensive conservation plan. Although the open-houses were lightly attended, there was considerable one-on-one discussion and many issues were identified. The planning process and meeting announcements were covered extensively by the local newspaper.

Prior to the open-house workshops, the Service sent letters to all individuals, organizations, and agencies that were on the Lahontan Valley Wetlands Water Rights Acquisition EIS mailing list to ask if they would like to be placed on the comprehensive conservation plan/boundary revision mailing list. The Service also sent letters to the landowners within the boundaries of Stillwater NWR and Stillwater WMA, and adjacent areas, summarizing the boundary revision assessment, inviting them to the workshops, and encouraging input on issues and alternatives to consider.

A second Notice of Intent was published in the *Federal Register* on June 15, 1998 (Volume 63, Number 114, pages 32676-32677) "to inform the public that the Service is preparing an

EIS for a comprehensive conservation plan for Stillwater NWR Complex and an associated boundary revision for Stillwater NWR."

1.3.1.1.2 Planning Updates, and Newspaper and Newsletter Articles

Prior to the release of this Draft EIS, the Service sent five planning updates to more than 200 interested individuals, organizations, and agencies to keep them informed of the comprehensive conservation planning and boundary-revision processes and to encourage public participation. The first planning update (April 1997) introduced the planning process, explained the importance of managing national wildlife refuges according to refuge purposes, told readers how to provide input into the planning process, and announced the times and locations of upcoming open-house workshops. The second planning update (June 1997) summarized the issues that were identified during the first several months of the planning process; listed draft goals for Stillwater NWR, Fallon NWR, and Anaho Island NWR; summarized the basis of draft goals; told readers how to provide input; and announced the time and location of upcoming open-house workshops. In the third planning update (July 1997), five boundary alternatives were described and an upcoming open-house workshop was announced. Planning updates four and five (May 1998 and March 1999) introduced the National Wildlife Refuge System Improvement Act of 1997, changes in management priorities brought about by the expiration of the 1948 Tripartite Agreement and subsequent management according to Public Law 101-618 and other pertinent laws, and summarized public and Service issues concerning the public use program.

Announcements of the planning process were also provided in several regional, national, and international newsletters of conservation and professional organizations, including *Waterfowl 2000* (North American Waterfowl Management Plan), *Intermountain Quarterly* (Intermountain West Joint Venture), *Network News*, (Western Hemispheric Shorebird Reserve Network), *Nevada Waterfowl Association Newsletter*, and newsletters of the Biological Diversity working group and the Nevada Chapter of The Wildlife Society.

The local newspaper, Lahontan Valley News and Fallon Eagle Standard, contained articles on the planning process and announced meeting dates on the following dates: March 7, 1997, April 1, 1997, April 22, 1997, May 1, 1997, May 2, 1997, July 1, 1997, July 2, 1997, and July 17, 1997. The March 1, 1999 issue of The Reno Gazette-Journal contained an article on the planning process.

1.3.1.1.3 Public Law 101-618 Cooperator's Meetings

Staff of the Stillwater NWR Complex periodically attended quarterly Public Law 101-618 Cooperator's meetings, participants include representatives from several Department of Interior agencies, Nevada State agencies, municipal governments, and Tribes. Short status updates were provided periodically and more detailed presentations were given on August 13, 1997, November 19, 1997, and February 26, 1998. In these presentations, the Service gave

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updates on the planning processes and asked for comments and feedback, and a planning update was distributed on March 3, 1999.

1.3.1.2 MEETINGS WITH AGENCIES, TRIBES, AND OTHER GROUPS

1.3.1.2.1 Other Federal Agencies and Departments

The Service met periodically, including July 1997 and January 1999, with representatives of the Bureau of Reclamation to discuss boundary revision, water management, and other issues. The Bureau of Reclamation assisted the Service with computer modeling of potential effects of Stillwater NWR water management on Newlands Project operations (Below Lahontan Reservoir model). The Service met with the Bureau of Land Management (BLM) on March 19, 1998 to discuss the boundary revision issue and potential effects of changes in refuge management on the adjacent BLM lands.

After receiving a letter from the Naval Air Station-Fallon (August 26, 1997), the Service met with Naval Air Station-Fallon on three occasions (September 8, 1997; March 11, 1998, and February 22, 1999) to discuss their concern about the potential expansion of Stillwater NWR northward toward the Bravo-20 Bombing Range.

U.S. Geological Survey (USGS) reviewed a conceptual model of the natural functioning of the Lahontan Valley wetland ecosystem, and provided input on improving the model. The Wildlife Services Agency, U.S. Department of Agriculture provided suggestions on animal damage control.

1.3.1.2.2. Nevada State

In addition to monthly coordination meetings between Stillwater NWR and Region 1 of the Nevada Division of Wildlife (NDOW), where planning issues were periodically discussed, the Service met with NDOW (Region 1) on five occasions to specifically discuss comprehensive conservation planning and potential revisions to the Stillwater NWR boundary (September 1997, October 1997, November 1997, May 1998, November 1998, and December 1999). In these meetings, Stillwater NWR staff briefed NDOW on the progress of the planning process and to obtain input on the habitat and public-use management options being developed. Major topics of discussion included sources of management direction; boundary revision options; natural hydrologic functioning; water management options; management of wildlife-dependent recreational uses; and hunting management, including different zoning options.

At a coordination meeting between the refuge managers and NDOW (July 18, 1997), several suggestions were made for the Service to consider for the comprehensive conservation plan for the Stillwater NWR Complex. At a coordination meeting between the Service and NDOW on April 23, 1999, the Service provided a brief summary of the planning process and issues being addressed. The Service also met with the Nevada State Board of Wildlife Commissioners in February 1999 to brief them on the planning process and to answer questions. The State Historic Preservation Office attended a meeting on cultural resource issues on Stillwater NWR (see below).

1.3.1.2.3 Tribes

The Service periodically met with representatives of the Fallon Paiute-Shoshone Tribe to discuss the potential boundary revision and other issues being addressed in the comprehensive conservation plan.

A status update was provided by the Service at the February 6, 1998 Pyramid Lake Paiute Tribe Coordination Meeting. Following this meeting, on March 24, 1998, the Service met with representatives of the Pyramid Lake Paiute Tribe to discuss Anaho Island NWR issues and other issues related to the development of the Stillwater NWR Complex comprehensive conservation plan and Stillwater NWR boundary assessment. On Nov. 4, 1999, the Service discussed the status of the Anaho Island Wilderness proposal with representatives for the Pyramid Lake Paiute Tribe at the DOI/Pyramid Lake Pauite Tribe Coordination Meeting.

1.3.1.2.4 Municipalities

The Service gave a presentation and answered questions at the October 15, 1997 Churchill County Commissioners meeting and at a November 19, 1997 Fallon City Council meeting. The presentation focused on the purposes and basis for planning and the scope of the plan and potential boundary revision, and provided an opportunity for representatives to present input to the Service. Prior to the Fallon City Council meeting, Stillwater NWR staff met with the City attorney and a contracting attorney to discuss the agenda of the City Council meeting. Written scoping comments on the planning process (letter dated May 21, 1997) were also received from the County.

The Service also met with the Churchill County Mosquito Abatement District (November 12, 1998) to discuss concerns of the district that were identified in the Wetlands Water Rights EIS. This was followed by telephone conversations with other professionals referenced by the mosquito district.

1.3.1.2.5 Private Organizations

The Service was invited to several meetings of private organizations. The Service provided planning background and status-updates at board meetings of the Nevada Waterfowl Association (June 1997, September 1998), Canvasback Gun Club (July 1997), and Ducks Unlimited (June 1998). Presentations were also made to the Reno Host Lions Club (May 1997), Fallon Host Lions Club (March 1998), the Lahontan Chapter of the Audubon Society

(January 1999), and Friends of Stillwater Coalition (January 1999). In each case, people attending the meetings were encouraged to provide input into the planning process.

The Service considered comments received in letters from various organizations on boundary revision alternatives and habitat and public-use management options. These organizations included the Toiyabe Chapter of the Sierra Club, Lahontan Wetlands Coalition, Nevada Waterfowl Association, The Nature Conservancy, and the Outdoor Education/Physical Education Office, Washoe County School District, and Friends of Stillwater Coalition.

Additional meetings with private organization are addressed in section 1.4.4.3.

1.3.1.3 TOPICAL MEETINGS AND TOURS

1.3.1.3.1 Livestock Grazing

Two livestock-grazing tours were conducted in which the Service received input from a variety of interest groups and professionals. The first meeting, conducted on July 7 and 8, 1997, was a review of the habitat management program by the Regional Office, Portland. Several professionals with expertise in rangeland and riparian systems (from the Agricultural Research Service and the University of Nevada-Reno) were invited to provide technical input. A report was produced by the Division of Operations Support, Regional Office that outlined recommended changes to the habitat management program of the Stillwater NWR Complex in relation to livestock grazing.

In the second meeting, of July 19, 1997, other professionals as well as people representing livestock grazing interests and environmental interests were invited to attend the meeting. Participants included representatives from the Natural Resource Conservation Service, the Nevada Chapter of the Society for Range Management, Nevada Chapter of The Wildlife Society, Nevada Wildlife Federation, Great Basin Chapter of the Sierra Club, and a private citizen. Several areas on Stillwater WMA, Fallon NWR, and Stillwater NWR were visited during the tour, and participants were asked to provide input on the livestock grazing issue. Many of the participants submitted letters further detailing their thoughts.

Prior to issuance of the 1997 and 1999 livestock grazing permits, Stillwater NWR staff informed livestock grazing permittees of the planning process, the general scope of the plan, and encouraged the permittees to provide input. One permittee visited the Stillwater NWR Complex office to discuss several issues with respect to the potential use of livestock grazing in managing wildlife on the Stillwater NWR Complex.

1.3.1.3.2 Contaminants

The Contaminants Division of Ecological Services, Reno, Nevada organized a meeting to address, in detail, the contaminant problems on the Stillwater NWR Complex for the

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comprehensive conservation plan. There were 12 participants, including representatives from several Service offices, USGS, Environmental Protection Agency (EPA), and the University of Nevada-Reno. Introductory presentations provided background on the planning process, environmental setting, and biological and contaminant concerns. Following this introduction, management and research options were discussed.

1.3.1.3.3 Other Habitat Management Issues

Stillwater NWR staff met with other professionals individually and in small groups to discuss various habitat conditions and habitat management techniques. Anticipating the development of a comprehensive conservation plan for Stillwater NWR Complex, staff toured various upland habitats with range ecologists from the Agricultural Research Service and the University of Nevada-Reno on May 19, 1994. Topics of discussion included range ecology in arid basins and the relationships between Indian ricegrass and kangaroo rats.

Stillwater NWR staff toured portions of Stillwater WMA with a fire ecologist on October 30, 1997 to gain a better understanding of the role that fire played in shaping Lahontan Valley habitats under natural and pre-Euro-American settlement times.

Stillwater NWR staff also met with representatives of the University of Nevada-Reno's Biological Resources Research Center and Biology Department, and contracted several inventories (Charlet et al. 1998, Rust 1998, Rahn 1999), and the preparation of a vegetation map for Stillwater NWR, Stillwater WMA, and Fallon NWR (Map 2.2, Charlet et al. 1998). Management implications and recommendations were included in reports.

As part of a contract with Ducks Unlimited, the Service is obtaining technical input on potential water management strategies. Through these communications, the Service refined alternative water management objectives and strategies.

1.3.1.3.4 Public-Use Management

An outdoor recreation planner from Region 6 of the Service spent the week of May 19, 1997 touring Stillwater NWR and Stillwater WMA with refuge staff, discussing public-use issues and providing recommendations on how to resolve these issues. This was followed by a similar working session attended by two Region 1 staff from the Division of Education, Publications, Interpretation, and Communications (EPIC) during the week of October 20, 1997. In each case, extensive recommendations were provided, and these were considered in the development of public-use alternatives.

A focus group was formed by the Lahontan Wetlands Coalition in December 1997 to develop public-use management options for the Service to consider. The Service was invited to this meeting as a technical advisor. The meeting resulted in a letter that outlined public-use management recommendations from the Lahontan Wetlands Coalition.

Later, the Service was invited to a coalition of hunting organizations to answer questions on potential changes to Stillwater NWR's hunting program and other aspects of public-use management. This meeting ultimately led to a letter (February 15, 1999) signed by 15 hunting, environmental, and other conservation organizations, and educators. The letter summarized recommendations on public-use management.

1.3.1.3.5 Cultural Resources

On January 13, 1997, Stillwater NWR staff met with the Service's Regional Archaeologist, the State Historic Preservation Officer, and the Naval Air Station-Fallon Archaeologist (who had formerly worked as an Archaeologist on Stillwater NWR) to discuss cultural resource management issues and to draft initial cultural resource objectives and strategies. Discussions with regional staff have continued and the Regional Archaeologist is a contributing planning team member.

1.3.1.4 COMMENTS ON THE DRAFT WATER-RIGHTS ACQUISITION EIS

Some of the comments that the Service received on the *Draft Environmental Impact Statement for Water Rights Acquisition for Lahontan Valley Wetlands* were also consider in this planning process. Issue topics included wetland water requirements, seasonal water-delivery schedule, use of acquired water, ways to reduce water quality problems, removal of dikes to restore Stillwater Marsh to pre-development conditions, desired mix of wetland habitat types, mosquito control, adverse impacts of beavers on riparian restoration, and a desire for a formal process that allows interest groups familiar with Stillwater Marsh to provide input on a regular basis.

1.3.1.5 OTHER OUTREACH

In June 1996, the Nevada Chapter of The Wildlife Society held their annual summer meeting at Stillwater NWR. This provided the Service an opportunity to present an overview of refuge management and the upcoming planning process, as well as to get initial input on wildlife-related issues. The annual midwinter meeting of the Nevada Chapter of The Wildlife Society was held in Fallon, Nevada on January 10, 1998 and the theme of the first several presentations was the restoration and the management of Lahontan Valley wetlands, from the perspectives of the Service, NDOW, and the Lahontan Wetland Coalition. Other presentations addressed studies of contaminants and bats in the Lahontan Valley, including Stillwater NWR. In a session on comprehensive conservation planning on refuges at the 1999 Western Section of The Wildlife Society conference in Monterey, California, results of modeling and inventories conducted at Stillwater NWR, and management recommendations were presented by the University of Nevada-Reno and a private consultant.

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1.3.1.6 FISH AND WILDLIFE SERVICE

The core planning team met about 45 times to discuss planning and management issues, discuss natural habitat conditions, develop alternative sets of objectives, alternative sets of strategies, formulate alternatives, and to identify potential consequences of each alternative. All or most of the core planning team members (see List of Preparers) attended these meetings, and there were numerous meetings and discussions among members in smaller groups. The planning team consisted of Regional Office staff (Regional Archaeologist), as well as representatives from the Reno State Office (Contaminant Specialist). The planning team worked closely with the Reno Office, Ecological Services in evaluating potential effects on threatened and endangered species. Four working sessions were held with Regional Office staff to discuss planning and management issues, alternative objectives and strategies, and potential impacts. The Regional Office also sponsored a habitat management review, which was discussed earlier (section 1.4.4.1).

1.3.2 MAJOR ISSUES

1.3.2.1 Issue Statements

Six major issues were identified during public and internal scoping process. Each of the major issue described below identify potential effects that a revised boundary and comprehensive conservation plan could have on a particular resource area. These issues, which are discussed in more detail in a Scoping Report (Appendix Q), were considered during the development of alternatives and evaluation of environmental impacts.

- Potential Effects on Populations of Fish, Wildlife, and Plants. Wildlife management at Stillwater NWR, Stillwater WMA, and Fallon NWR has traditionally focused on game species, especially waterfowl. Thus, concern was raised that any changes to this traditional focus, such as any changes in water management strategies, controlling or not controlling certain nest predators, and fisheries management, may affect waterfowl. In recent years, other migratory birds such as shorebirds and colonial-nesting species have been receiving more management attention. Given the directive to manage Stillwater NWR to conserve the natural biological diversity within the refuge, which includes all native species of fish, wildlife, and plants, there is interest in the effects that future management may have on these other groups of organisms. (Section 1.3.2.2.1 provides additional detail on a related issue.) Continued protection of colony-nesting birds at Anaho Island is the main issue with respect to Anaho Island NWR.

  Boundary revisions within the Stillwater NWR Complex can also affect populations of animals and plants, primarily through increased protection and restoration of sensitive habitats such as riparian and dune habitats. Other potential effects of a boundary revision include the enhanced protection afforded to reptile populations from commercial collection in Churchill County.

Another issue of concern, given the high importance of providing wildlife-dependent recreational uses on Stillwater NWR, is the potential adverse impacts to wildlife resulting from people walking, driving, boating, hunting, and approaching wildlife in wildlife habitat. This is further discussed in Section 1.3.2.2.2.

- Potential Effects on Habitat and Ecosystem Functioning. Methods of managing water and vegetation can have major effects on animal and plant populations, positive and negative. Therefore, the effects of the comprehensive conservation plan on habitat management, including the selection of management methods and intensity of use, is of concern to many people. Most public comments on habitat management addressed the management of water and livestock, and their effects on habitat quality. Another important habitat issue on the Stillwater NWR Complex is the effect that different management strategies have on the distribution and abundance of several nonnative invasive plant species, such as saltcedar, perennial pepperweed, and cheatgrass. This issue applies to all units in the complex. Several water-born contaminants are also of concern. There is much interest in the effects that managing newly acquired water rights will have on wetland-habitat on Stillwater NWR. The major habitat areas that could be affected by a boundary revision are the Carson River corridor, the sand dune complex, a vast expanse of saltdesert shrub habitat, and the southwestern portion of the Carson Sink.

- Potential Effects on Recreational, Educational, and Interpretive Opportunities. Many people, including Service personnel, recognize the great potential that the Stillwater NWR Complex has for providing high-quality opportunities for wildlife-dependent recreational uses. The Service has clear direction to facilitate compatible wildlife-dependent recreational uses on Stillwater NWR. Two main issues surfaced during scoping: (1) members of the hunting public and others have asked that the waterfowl hunt program remain much as it is today, including no change in the boundary of the hunt zone; and (2) people representing a variety of interests have asked that the Service provide better facilities and information for birdwatchers, environmental educators, wildlife photographers, and other people interested in learning about the refuge's wildlife, habitats, and cultural resources. Although many issues were brought to the attention of the Service, these appear to the be central issues. Interest was expressed in raising the limit on motorboats to 15 horespower during the hunting season. Section 1.3.2.2.2 provides additional detail on this issue.

  Other issues include the potential effects on opportunities for horseback riding, camping, access to desert areas, and hunting in upland habitats. For example, in contrast to some people envisioning additional opportunities created by expansion of Stillwater NWR's boundary (e.g., for birdwatching along the Carson River), others expressed concern that it would diminish opportunities by restricting road access and disallowing certain activities (e.g., coyote and jackrabbit hunting, and off-road vehicles).

- Potential Effects on Cultural Resources. Habitat management activities, facilities maintenance, recreational use on the refuge, and a variety of environmental factors have the potential to affect cultural resources on the refuge. Cultural resources on Stillwater NWR and WMA are essential elements of individual and group identity for members of the Fallon Paiute-Shoshone Tribe. The cultural resources on Stillwater NWR and WMA are some of the most important cultural resources in Nevada, and the entire Stillwater Marsh has been placed on the National Register of Historic Places. Although cultural resources, especially archeological sites, pervade Stillwater Marsh, they are fragile, easily disturbed and destroyed, and are nonrenewable. Cultural resources are small and subtle compared to the surrounding landscape and contemporary features like roads, ditches, and visitor facilities.

  The most critical issue with respect to the comprehensive conservation plan being prepared and potential boundary revision revolves around the basic question: How should cultural resources be protected and interpreted, given the need to manage wildlife habitat and public use of Stillwater NWR? Specific issues that need to be addressed include, (a) providing adequate protection of cultural resources from inadvertent disturbance by the public, while still allowing the public to enjoy a wildlife and cultural experience on the refuge; (b) reducing illegal artifact collecting and looting, while still allowing hunters and other recreationists to access the most archaeologically sensitive areas of the marsh; (c) implementing an environmental education program that incorporates accurate archaeological and cultural information including appropriate consultation with the Fallon Paiute Shoshone Tribe; and (d) the effects of manipulating water levels, and the replacement and construction of necessary infrastructure on cultural resources, and the potential mitigation of these activities.

- Potential Effects on the Local Agriculture and Socio-Economy, and the Newlands Irrigation Project. The Service was encouraged to look into ways to explore the use of spill-water and to reassess the volume and water quality of drainwater and groundwater reaching Stillwater NWR. Another suggestion was to reevaluate water-rights acquisitions based on recent adjustments to the 1988 Operating Criteria and Procedures (OCAP) for the Newlands Irrigation Project. Because the Service will have a considerable portion of water rights in the Carson Division, changes in the seasonal water-delivery pattern has the potential to affect Newlands Project operations and Truckee River resources. Any changes to livestock grazing management on Stillwater NWR and Fallon NWR, in combination with any revisions to the boundary of Stillwater NWR could potentially affect the local economy. The most direct economic effects of changes would be on livestock grazing permittees. Changes in recreational opportunities could also affect the local economy.

- Potential Effects on Naval Air Station-Fallon Operations. The U.S. Navy expressed concern that a boundary revision of Stillwater NWR could potentially affect their tactical training at the Bravo-20 Bombing Range. A 3,000-foot ceiling currently exists over Stillwater NWR, Fallon NWR, and Stillwater WMA, meaning that aircraft are not permitted to fly lower than 3,000 feet over this area. The 3,000-foot ceiling would not apply to any northward extension of Stillwater NWR.

1.3.2.2 Further Analysis of Issues

The National Environmental Policy Act of 1969 (NEPA) requires that all major issues identified during scoping (Section 1.3.2.1, above) be identified and described, but it does not specify which particular issues should be addressed in any given situation. The Refuge System Administration Act, however, does specify two issues that are to be addressed in the comprehensive conservation planning process: (1) identification and description of significant problems that may adversely affect populations and habitats of fish, wildlife, and plants within the planning unit, and the actions necessary to correct or mitigate such problems; and (2) identification, description, and facilitation of opportunities for wildlife-dependent recreation and a determination that allowed levels and distribution of these uses will be compatible with refuge purposes. Of the issues identified during scoping, these two issues provided the primary guidance in developing objectives and strategies to achieve refuge goals and purposes, and are therefore described in a little more detail on the following pages. The compatibility determination process was incorporated into the comprehensive conservation planning effort and draft compatibility determinations are included in this Draft EIS (Appendix O).

1.3.2.2.1 Significant Problems Adversely Affecting Fish, Wildlife, and Plants

To ascertain significant problems within the Stillwater NWR Complex, existing conditions were compared with desired, future conditions as reflected by refuge purposes and provisions of the Refuge System Administration Act (such as the directive to ensure the maintenance of biological integrity and environmental health). For the purposes of this Draft EIS, significant problems were defined as the underlying factors impeding the achievement of wildlife and habitat-related purposes of Stillwater NWR and Fallon NWR. The underlying factors hindering achievement of these purposes are:

- Reduced volume and altered timing of inflows, and flow restrictions in Stillwater Marsh, and along the lower Carson River and its delta, as compared to natural conditions;

- Prevalence and spread of nonnative plant and animal species in wetlands, riparian areas, and uplands; and

- Altered chemistry of wetland inflows.

The first two are the major habitat issues that must be resolved or otherwise addressed in order to meet statutory requirements. Because several contaminants have been found to exceed thresholds associated with adverse effects to wildlife, contaminants are also of concern. These three problems are summarized below and described in more detail in

Appendix N. In addition to management implications, they also have implications to the potential boundary revision.

Several other factors have the potential to limit the Service's ability to achieve wildlife-related purposes. One factor is the effect of human activity on wildlife and their habitat. This is discussed in more detail in Section 1.3.2.2.2. Other problems that will continue to have adverse effects on wildlife on the refuges are land-use practices and human activities that occur outside the refuges and throughout North, Central, and South America. Included are alterations to Carson River flow caused by agricultural, municipal, and industrial activities and Lahontan Reservoir, and habitat destruction, pollution, and pesticide use throughout the Western Hemisphere. These off-refuge problems cannot be addressed through refuge management, but need to be recognized when setting wildlife and habitat objectives. Even though they cannot be addressed on-refuge, the effects that these off-refuge problems have on refuge resources highlights the need for the Service to continue its involvement in water allocation and management issues in the Truckee-Carson River basins, development and implementation of international bird conservation initiatives, and other large scale efforts.

Reduced Volume and Altered Timing of Inflows, and Flow Restrictions

The major factor that has and continues to affect wetland wildlife and other components of natural biological diversity within the alternative boundaries of Stillwater NWR is altered hydrology. This includes significantly reduced volume (and rate) of water flowing into and through the lower Carson River and marshes, altered timing of water flowing through these habitats, and pattern of flow through the marshes. Of these, water volume is the most critical. Water volume has a major influence on fish and wildlife communities because of its effects on wetland-habitat acreage, water depth, and water chemistry. Even with the completion of the water-rights acquisition program (long-term average of 70,000 acre-feet/year), the volume of water entering Stillwater NWR will be far below the amount that historically flowed into Stillwater Marsh, an estimated average of 270,000 acre/year (Kerley et al. 1993). Also, the amount of water to enter Stillwater Marsh will be an estimated 5 acre-feet/acre/year (USFWS 1996a), as compared to an estimated average of 15-25 acre-feet/acre/year, which occurred under natural conditions (assuming 25,000 acres of wetland-habitat.

Following the construction of the Lahontan Reservoir and further regulation of the lower Carson River, inflow of fresh water directly from the Carson River into the Lahontan Valley wetlands was significantly reduced and drainage from agricultural areas became an increasingly larger component of the wetland water supply. Until the late 1960s, the wetlands received substantial amounts of water during the winter as a byproduct of winter hydropower generation. Increased irrigation efficiencies mandated under OCAP in the 1970's curtailed winter hydropower generation and further reduced the inflow of fresh water. The resultant dependence on drainwater resulted in a shift in water delivery patterns to wetlands, with inflows to wetlands corresponding to the release of irrigation water from Lahontan

Reservoir over the agricultural growing season. Reduced inflow of water and diking disrupted the flow-through character and increased the amount of time that water remained in some wetland areas. Such changes reduced the frequency and efficiency of flushing of dissolved solids through the wetlands. The high rate of evaporative water loss in this hydrologically-isolated basin has contributed to accumulation and concentration of dissolved constituents in wetlands (Seiler 1995). Concentrations of dissolved solids, including a variety of major and trace elements, was further elevated by the drainwater being received from agricultural drainage, including surface runoff from fields and subsurface drainage.

Some of the components of natural biological diversity that were adversely impacted by these changes include the number and abundance of migratory bird species breeding in Stillwater Marsh and along the Carson River, production of migratory birds and other wildlife, number of migratory birds using the area as a stopover, presence and abundance of certain species of invertebrates, overall extent of marsh vegetation, prominence of particular plant communities, and successional pathways. As compared with historic accounts, plant dominance has shifted to more saline-tolerant species and assemblages. In some cases, historically described saline intolerant plant associations, such as milfoil (*Ceratophyllum demersum*), no longer occur in Lahontan Valley (Bundy et al. 1996). Currently, dominant invertebrate species are moderately to highly-tolerant of salinity and altered water chemistry (Plafkin et al. 1989), contrasted with historic wetland conditions which included extensive areas of freshwater. Species sensitive to salinity and alkalinity are absent and overall number of invertebrate species is low.

Although the significant reduction in wetland-habitat acreage is likely the major factor affecting these components of wildlife and habitat diversity, the significant reduction in flow rates of fresh water into and through the marsh and lower river corridor has likely led to marked changes in marsh and riparian ecology and the diversity of species that are seen today. Loss of deeper-water channels running through the marsh has likely impacted native fish and other wildlife by reducing the number of areas that could retain small acreages of water (e.g., low surface area and thus low evaporation) during droughts, although this impact is likely outweighed by the overall reduction in wetland inflows and introduction of nonnative fish. A more detailed description of natural hydrologic conditions and associated wildlife and plant communities is provided in Chapter 2.

Prevalence and Spread of Nonnative Plant and Animal Species

Another major factor impacting native wildlife and plant communities within the Stillwater NWR Complex is the introduction, continued influx, prevalence, and spread of certain introduced plant species (e.g., saltcedar in riparian and marsh habitats; and cheatgrass in uplands) and animal species (e.g., bullfrogs, European carp, and other fish in marshes; and cattle and European starlings in riparian areas). Saltcedar, for example, has had a significant impact on some plant communities within the Stillwater NWR Complex. Vast areas of meadow habitat once dominated by grasses, rushes, and sedges has converted to saltcedar-dominated communities with scant undergrowth. Monotypic stands of saltcedar are replacing mixed deciduous shrub/tree communities in riparian areas and emergent vegetation in marshes. Some plant communities have changed so much due to invasion of nonnative plants that they no longer resemble the original community. Seventy-two of the 192 wetland plant species now inhabiting Lahontan Valley wetlands (38 percent) are nonnative species; most of which are annual forbs and grasses (Bundy 1996). Introduced species are a major component of the area's biological diversity.

Altered structure of native plant communities due to cattle grazing has adversely impacted native wildlife and plant communities on the Stillwater NWR Complex (Appendix M). The long history of cattle grazing has contributed to the alteration of the natural structural diversity of vegetation, reduced the height and stature of native grasses, rushes, and forbs in meadow and riparian communities, which has shown to affect native bird and small mammal communities in other areas, as summarized in Appendix M. This was also addressed in Charlet et al. (1997). Significantly reduced volumes and altered timing of Carson River flows is another factor that has contributed to deteriorated riparian conditions.

Cheatgrass is having a considerable impact on native plant communities in some upland areas of the refuge. Cheatgrass produces extensive ground cover in areas previously characterized by large proportions of open ground, which may affect species requiring spacing between plants (e.g., native lizards and kangaroo rats). Another attribute of cheatgrass-dominated communities is their propensity for frequent burning. This would have devastating impacts to native salt-desert shrub communities that evolved with very infrequent fires. Being an annual, cheatgrass thrives under frequent burning.

European carp, brown bullhead, largemouth bass, mosquito fish, and other nonnative fish dominate the fish communities in the Stillwater NWR Complex. A total of 15 introduced fish species occur in the Lahontan Valley, compared to one native fish species that remains today, of the two species native to the valley. The composition of fish communities is significantly altered. Furthermore, European carp can adversely impact water turbidity and plant communities, and thus wildlife communities, of marsh ecosystems. Several species of introduced game fish inhabiting Stillwater NWR Complex have been shown to significantly affect populations of native invertebrates and amphibians in other areas. Largemouth bass can adversely impact waterfowl broods. Bullfrogs have been shown to significantly alter amphibian diversity in studied areas, and this may be a contributing factor to the marked decline in leapord frog populations in the Lahontan Valley. It may also be one reason why Western toads have not been recorded on the refuge. Bullfrogs could also be impacting the existing population of spade-foot toads. European starlings have had significant adverse impacts on native cavity-nesting birds throughout North America. They are aggressive competitors and likely have marked impacts on the ability of native cavity-nesting birds (e.g., wood ducks, American kestrels, northern flickers) to find suitable nesting sites along the lower Carson River.

Altered Chemistry of Wetland Inflows

A variety of environmental contaminant concerns have been identified on the Stillwater NWR. Contaminant concerns are primarily related to the historic release of mercury into the Carson River and its tributaries and the hydrologic modification of the lower Cason River basin. The historic release of mercury to the Carson River continues to affect the quality of water conveyed to Stillwater NWR, particularly during large upriver flood events. Other concerns involve potentially toxic trace elements. Previous investigations, prior to water rights being acquired for the wetlands, identified concerns with un-ionized ammonia, and 12 trace elements in water, sediment, and biological samples from Stillwater NWR. The trace elements aluminum, arsenic, boron, and mercury were identified as contaminants of primary concern. The environmental contaminant concerns in Stillwater NWR wetlands are largely attributed to human modification of natural hydrologic characteristics and processes of wetlands, and wetland water supplies. Contaminants at concentrations identified in water, sediment, and biological samples from Stillwater NWR have the potential to produce a range of direct and indirect adverse effects to fish, wildlife, and habitat quality in Stillwater NWR. As proportionally more wetland inflow consists of irrigation-quality water and the proportional amount of drainwater inflows shrink, these contaminants will be of lesser concern.

Prior to the onset of the water-rights acquisition program, Hoffman et al. (1990) found that, water in Stillwater NWR has contained concentrations of arsenic, boron, dissolved solids, sodium, and un-ionized ammonia in excess of baseline conditions or Federal and State criteria for the protection of aquatic life or the propagation of wildlife. This has primarily been a consequence of receiving drainwater from agricultural areas, including surface runoff from fields and subsurface drainage, which commonly contains elevated concentrations of dissolved solids, including a variety of major and trace elements mobilized from soils or local groundwater. Concentrations of arsenic, boron, copper, mercury, selenium, and zinc in biological tissues collected from some affected wetlands exceeded levels associated with adverse biological effects in other studies. Organochlorine compounds were detected in sediments collected from wetlands of Stillwater NWR. Of greatest concern was lindane in normalized concentrations which exceeded the EPA sediment quality criteria in three samples. This study concluded that arsenic, boron, mercury, and selenium were of primary concern to human health and fish and wildlife in and near the Stillwater NWR. Subsequent studies have generally supported these findings (Lico 1992, Hallock and Hallock 1993, Tuttle et al. 1996, Tuttle et al. in preparation). Although the completion of the water-rights acquisition program will resolve these problems to a great extent, use of groundwater as outlined in the water-rights acquisition program could offset many of these gains (USFWS 1996a).

Under most conditions, environmental contaminants do not appear to threaten aquatic bird recruitment. For example, Hallock et al. (1993a) found that concentrations of arsenic, boron, mercury, and selenium in eggs from collection sites were below levels associated with

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embryotoxicity or reduced hatchibility. Consistent with these findings, hatching success of duck eggs collected from Lahontan Valley (90 percent) was within the range expected of healthy duck populations. However, Tuttle et al. (in preparation) found that boron in a majority of the sampled aquatic bird eggs exceeded a concentration associated with sublethal effects to hatchlings. Mercury in a third of the eggs exceeded concentrations associated with sublethal effects, while a limited number exceeded potentially embryotoxic levels. The magnitude of the contaminant problem in the Stillwater area remains unclear.

1.3.2.2.2 Providing Opportunities for Compatible Wildlife-Dependent Recreation

The Refuge System Administration Act requires the Service to (1) facilitate high-quality and safe opportunities for wildlife-dependent recreation and (2) ensure that this is done in a way that is compatible with refuge purposes and the Refuge System mission.

> "...We will make refuges welcoming, safe, and accessible, with a variety of opportunities for visitors to enjoy and appreciate America's fish, wildlife, and plants..."
>
> *U.S. Fish and Wildlife Service (1999)*

These two requirements may at first seem to oppose each other because one involves facilitation of uses and the other involves constraints on uses, one viewed as positive and the other viewed as negative. However, a closer examination reveals that they complement each other. One of the dominant principles of refuge management is that, taken together, high-quality wildlife-dependent recreational experiences depend on a rich diversity and abundance of wildlife and habitat. Without this resource, traditional uses of refuges could not be sustained. Additionally, continued use of refuges for wildlife-dependent recreation provides people with a better understanding and deeper appreciation of wildlife and the importance of conserving their habitat, which ultimately contributes to the conservation mission of the Refuge System through increased public support.

Conversely, high levels of human activity on refuges can diminish the benefits the refuge can potentially provide to wildlife, and this is the reason why compatibility determinations are such an important part of refuge management. A quote from the first Refuge Manual (U.S. Fish and Wildlife Service 1943) shows that examining and attempting to resolve potential conflicts between wildlife and public uses is not a new issue for national wildlife refuges: "Public use of refuge areas will in varying degrees result in disturbances to wildlife populations, but this adverse effect will be offset on many refuges by the public relations value of limited public use." To make sure that the fundamental mission of the Refuge System is not materially impaired, some constraints need to be imposed on uses.

With these factors in mind, the ultimate aim of this planning process for public use management is to create a plan that truly facilitates and promotes an array of wildlife-

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dependent recreational opportunities, the combined effects of which the Service can confidently demonstrate are compatible and consistent with refuge purposes. This has proven to be a challenge given the limited amount of relevant site-specific biological data and the controversy that has resulted from exploring this issue. What is known from the available information is that hunting is generally compatible with refuge purposes and that boating has the greatest potential to hinder achievement of refuge purposes. Boating is not a priority public use of the Refuge System and tends to be more restrictive on refuges. An estimated 20 percent of hunters used boats during the 1999-2000 hunting season. The main impacts caused by boating stem from their noise, speed, and easy access to all open habitats.

The following sections address the facilitation and compatibility issues further.

Facilitating Wildlife-Dependent Recreational Uses

The direction provided in the Refuge System Administration Act and Stillwater NWR purposes (Public Law 101-618) is very clear: opportunities for scientific research, environmental education, and other wildlife-dependent recreational uses are to be facilitated on Stillwater NWR. "The term 'facilitate' was deliberately chosen [for the Refuge System Improvement Act] to represent a strong sense of encouragement, but not a requirement, that ways be sought to permit wildlife-dependent uses to occur if they are compatible" (House Report 105-106).

Furthermore, the Refuge System Administration Act specifically requires that the priority general public uses of the Refuge System (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) receive enhanced consideration over other general public uses in refuge planning and management. A related issue is the requirement in comprehensive conservation planning to identify and describe areas in the planning unit that are suitable for use as visitor facilities or administrative sites.

The requirements of Public Law 101-618 and the Refuge System Administration Act represent a shift in the management authorities governing the management of the Stillwater NWR Complex. Until the comprehensive conservation plan is approved and implementation begins, Stillwater NWR and Fallon NWR will continue to be managed under provisions of the 1948 Tripartite Agreement. Under this agreement, hunting has been the priority public use and it has had coequal status with wildlife conservation. Many other recreational activities have been allowed on Stillwater NWR, Stillwater WMA, and Fallon NWR, including fishing, wildlife observation and photography, camping, boating, and horseback riding.

The conversion from operation under the 1948 Tripartite Agreement to operation under the Refuge System Administration Act and refuge purposes under Public Law 101-618 has the potential to affect the availability and quality of recreational opportunities.

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Emphasis given to wildlife viewing and environmental education has been increasing during the last 10 years or so, but much more can be done to facilitate these uses on Stillwater NWR. Hunting will continue to be a cornerstone of the recreation program, and will likely be the most popular recreational activity for many years to come. Other uses not defined as wildlife-dependent, such as camping, horseback riding, boating, and bicycle riding, can only be permitted if they are determined to be both appropriate uses of a refuge and compatible with refuge purposes and the Refuge System mission. Uses not dependent on wildlife (those not identified as priority public uses of the Refuge System) are being de-emphasized.

Ensuring Compatibility

Just as the Refuge System Administration Act clearly calls for refuge managers to facilitate opportunities for wildlife-dependent recreation, it also clearly requires managers to make sure that these and other such uses are compatible with refuge purposes before they are permitted. The Act notes that hunting, fishing, wildlife observation and photography, and environmental education and interpretation have generally been found to be compatible uses of the Refuge System. The Act recognizes, however, that not all of these uses will be found compatible on all refuges. This is illustrated by the example provided of Blackwater NWR, Maryland, in which hunting is not permitted (House Report 105-106). Some refuges do not provide any public access.

> "To ensure that the Refuge System's fish, wildlife, and plant resources endure, the law of the land now clearly states that their needs must come first."
>
> *U.S. Fish and Wildlife Service (1999)*

The Act also recognizes that, although a use may be identified as generally compatible on a given refuge, whether it is actually compatible depends on how the program for the use is designed and operated. The design of the existing public use program reflects the philosophy of the 1948 Tripartite Agreement. The current planning process has involved evaluating and designing a public use program according to the standards set by Public Law 101-618 and the Refuge System Administration Act. Further examination of the public use program in light of these new standards led to the development of the following problem statement.

Under the existing public-use program, there are insufficient provisions to:
(1) ensure that providing for the needs of wildlife is not being impaired, and
(2) provide suitable opportunities for environmental education and wildlife viewing outside the hunt area during October-December.

Many factors are involved, including the change in management authorities governing the management of the area, biological and scientific information, professional judgement, and

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other input received during scoping. The first item in the problem statement involves three main interrelated factors: (1) boating and road access, (2) hunter density and distribution, and (3) amount and quality of sanctuary. During the past several years, hunter densities on Stillwater NWR have been relatively low, and it is generally recognized that a low density of hunters affects waterfowl and other wildlife less than a high density of hunters. Sanctuary is not as high of a concern if hunter density is low enough to allow waterfowl to find high-quality habitat in relatively undisturbed areas outside the sanctuary. However, even a few airboats and other motorized boats can counteract low hunter density, meaning that more sanctuary would be needed to ensure that birds can readily access high-quality habitat in a relatively undisturbed area. Extensive published scientific information summarized in Appendix L suggests that the effects of liberal boating in Stillwater Marsh during the hunting season may have as much or more to do with altered waterfowl distribution than the effects of hunting by itself. Road access is another factor influencing hunter distribution and density.

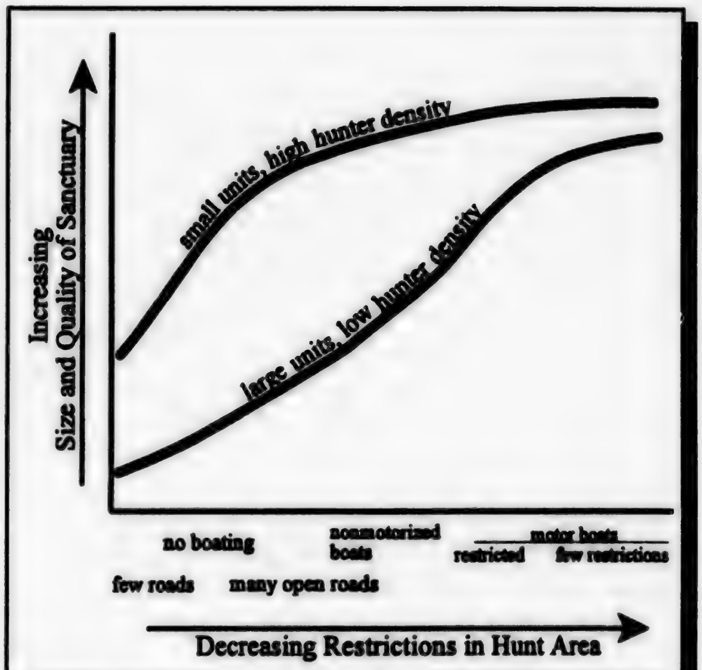

Figure 1.1. Graphic illustration showing the general relationship between the level of restrictions in a hunt area and the amount of sanctuary needed to counterbalance the effects of disturbance, assuming wildlife welfare is the highest priority, under two different scenarios.

Figure 1.1 is included to help explain the relationship between these three parts of the issue. It generally illustrates that the need for sanctuary is somewhat lower for an area comprised of large wetland units with relatively low hunter density as compared to an area comprised of many small wetland units and many hunters, although the allowance of airboats and other motorboats would tend to equalize the effects.

In addition to increased access, two other key factors that can affect waterbirds are the speed and noise produced by boats. The adverse effects of boating speeds and noise, which is well documented in the scientific literature (Appendix L), compounds the effects of increased access afforded by boats. At present, there are few regulations being enforced to control these three major sources of impacts from boats.

Therefore, under anticipated average water conditions (or better) and assuming relatively low hunter densities, the issue in many ways boils down to a relationship between the level

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of boating restrictions and amount of sanctuary (Figure 1.1). The more liberal the boating regulations are, the more sanctuary is needed. Conversely, the more that boating access, speed, and noise are minimized, the lower the needs are for sanctuary.

There are several concerns related specifically to the adequacy of the existing sanctuary. Although several units in the existing sanctuary are rated among the top producers of submergent aquatic vegetation on the refuge, the sanctuary does not provide the full range of habitat conditions to meet the day-to-day needs of waterfowl throughout the hunting season. For example, preferred foods of dabbling ducks (the majority of ducks using Stillwater NWR) are only sparsely provided in the sanctuary under existing management. Due to the different configurations of the wetland units, escape and thermal cover is more plentiful in wetlands outside of the sanctuary. For example, wetland units in the sanctuary have simple shorelines compared to the highly complex shorelines in other wetland units.

Another limitation to providing high-quality habitat in the sanctuary for feeding, resting, and thermal protection is that Stillwater Point Reservoir, comprising 33 to 45 percent of the sanctuary during October-December, is the refuge's main regulating reservoir, and it only accommodates an estimated 10 to 17 percent of the ducks using the sanctuary (Appendix E). Thus, up to 90 percent of the birds in the sanctuary must make use of half to two-thirds of the remaining sanctuary. Operating the

What is a Sanctuary and Why is it Needed?

A sanctuary is a place where wildlife can find high-quality habitat for breeding, feeding, resting, and seeking cover from weather and predators without being disturbed by the activities of people. Studies have consistently demonstrated that disturbance by people, even at low levels, can result in energetic costs to birds. Without adequate sanctuary in hunted areas, energetic costs can exceed replenishment, ultimately impacting production and even survival.

Achieving Stillwater NWR purposes requires that sanctuary be provided for wildlife.

When is Sanctuary Critical?

During the breeding season, when human disturbance has the potential to cause elevated nest depredation, nest abandonment, and mortality of nestlings and fledglings (generally March 1-July 15 at Stillwater).

During fall migration and the winter maintenance period, when migratory birds are acquiring carbohydrates for migration and winter maintenance (generally late September - early January at Stillwater).

Where Should Sanctuary be Located?

Given the fundamental mission of the Refuge System, the sanctuary (i.e., the area dedicated to wildlife) should encompass the highest quality habitat where birds can forage undisturbed and find protection from inclement weather.

How Much Sanctuary is Needed?

The amount of sanctuary needed depends on a great many factors, some of which are illustrated in Figure 1.1. A general rule depicted in the figure is that, as intensity of use by people goes up in the area open to public use, the more sanctuary must be provided.

reservoir as a regulating reservoir impairs its ability to provide suitable habitat for many waterbird species. Several people suggested changes to management that would enhance habitat quality within the existing sanctuary.

The second part of the underlying problem addresses environmental education and wildlife observation. Service policy requires that environmental education sites be provided outside the hunt areas. Environmental education is especially relevant to Stillwater NWR because environmental education is the only priority public use specifically identified in refuge purposes. At present, there is no place outside the hunt area for people to view birds or for the Service to take school groups and other groups during the hunting season, except one small parking area next to the maintenance shop. Although several individuals and groups have commented that this is not a problem because combined use of the same area tends to maintain unity and cohesion among the different user groups, other people have expressed that they would like opportunities to be provided outside the hunt area during the hunting season.

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CHAPTER 2.
AFFECTED ENVIRONMENT

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Chapter 2
AFFECTED ENVIRONMENT SUMMARY

2.1 INTRODUCTION

This chapter provides an introduction to the Stillwater NWR Complex and EIS study area, but does not provide a comprehensive overview of information. Details on baseline conditions for each resource are provided in Chapter 4 in conjunction with discussions of conditions anticipated to occur under the No Action Alternative, or status quo alternative. This format avoids repetition of baseline information and places the details of baseline conditions in the same place as details on the potential changes to these conditions.

The focus of this Draft EIS is the Stillwater NWR Complex (Stillwater NWR, Stillwater WMA, Fallon NWR, and Anaho Island NWR). However, because the alternatives being considered could potentially result in environmental impacts outside the Stillwater NWR Complex, the EIS study area is larger. It includes all areas where measurable environmental impacts could potentially occur: the Carson River Basin basin below Fort Churchill, the lower Truckee River basin below the Derby Diversion Dam and Pyramid Lake, and the Truckee Canal, which connects the two basins (Map 1.2).

The environmental characteristics of both basins have been thoroughly described in three recent environmental documents that are incorporated by reference: *Final Environmental Impact Statement Water Rights Acquisition for Lahontan Valley Wetlands* (USFWS 1996); *Draft Environmental Impact Statement Truckee River Operating Agreement* (USDI 1997); and *Environmental Assessment Adjusted 1988 Newlands Project Operating Criteria and Procedures* (USDI 1997).

Another function of this chapter is to describe the natural ecological conditions of the Lahontan Valley, of which Stillwater NWR is a part. Natural biological diversity, biotic integrity, and environmental health is central to Stillwater NWR purposes, provisions of the Refuge System Administration Act, and international treaties. It is recognized that ecological habitat conditions cannot be totally restored, nor in some cases would this be desirable. However, an understanding of the natural functioning of the Lahontan Valley wetlands and the composition and structure of Lahontan Valley habitats is needed before objectives and strategies targeting natural biological diversity can be developed. Section 2.5 is more detailed than the section on the existing condition of refuge resources (Section 2.4) because Section 2.4 only presents a summary of existing conditions, with the details presented in Chapter 4.

This Chapter is divided into four main sections. The first section (2.2) introduces the "biogeographical" context within which Stillwater NWR Complex is situated (Map 2.1). It highlights the international, regional, and landscape levels. The second section (2.3) delves into the landscape context in more detail, as a basis for summarizing the EIS study area. Section 2.4 focuses directly on the lands and waters within the Stillwater NWR Complex, and the final section (2.5) describes in more detail the natural ecological conditions of the Lahontan Valley.

2.2 INTERNATIONAL, NATIONAL, REGIONAL, AND LANDSCAPE CONTEXT

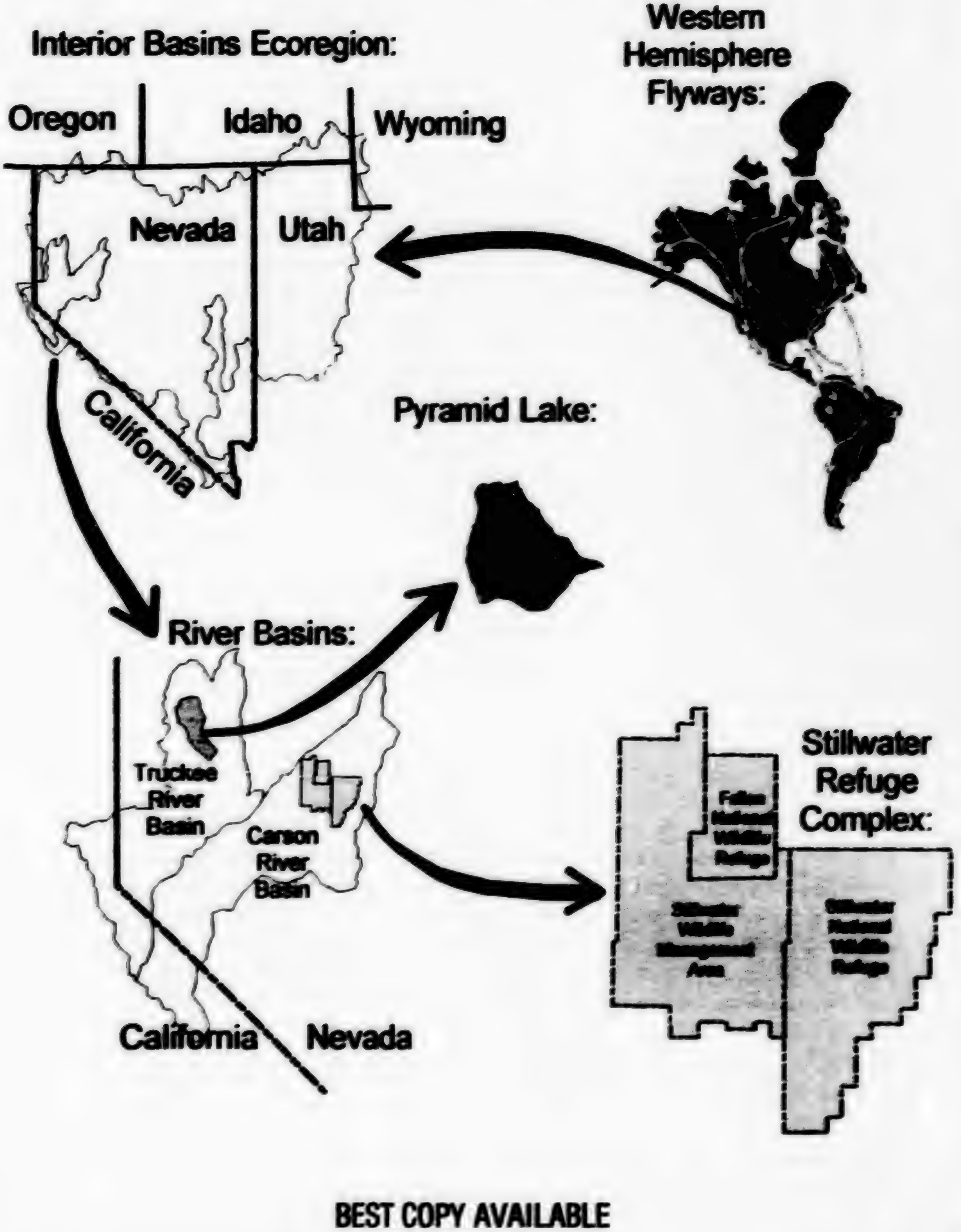
2.2.1 International and National

The Stillwater NWR Complex is nationally and internationally important in several ways. Most notably, the Stillwater NWR Complex provides important migration, breeding, and wintering habitat for migratory birds, including waterfowl, shorebirds, and neotropical migratory birds. As an illustration of their international importance to migratory birds, the Lahontan Valley wetlands, of which Stillwater NWR is a major component, is one of only 14 Western Hemispheric Sites of the Western Hemispheric Shorebird Reserve Network. The Lahontan Valley wetlands are also a focus area of the Intermountain West Joint Venture, a public/private partnership formed to meet objectives of the North American Waterfowl Management Plan within the boundaries of the joint venture. The North American Waterfowl Management Plan established a cooperative effort between Canada, the United States, and Mexico to reverse declines in waterfowl populations and their habitat. The Service is also a partner in the international Partners in Flight program, a voluntary collaboration of governmental and private organizations in North, Central, and South America (Section 3.2.1.2.4.1 for more detail). Stillwater NWR was designated as an Globally Important Bird Area in 1998 by the American Bird Conservancy. Globally Important Bird Areas are places of global significance to the conservation of birds, and they are designated to bring recognition to these important areas.

At an international level, the United States is also obligated to conserve wetlands, biological diversity, and natural areas through the establishment of refuges and other protected areas, and through establishment and enforcement of regulations. Stillwater NWR and Fallon NWR contribute to these obligations by protecting and enhancing wetland-habitat, conserving natural biological diversity, and protecting natural features of the landscape.

The Stillwater NWR Complex is also important nationally, and possibly internationally, for its public-use benefits both on and off the refuge complex. The waterfowl produced and fed on Stillwater NWR are seen by birdwatchers and harvested by waterfowl hunters throughout the Pacific Flyway. American white pelicans produced on Anaho Island NWR are enjoyed by birdwatchers and casual wildlife observers up and down the west coast. Long-billed dowitchers, other shorebirds, and other waterbirds that rely on Stillwater NWR's wetland-habitat during

Map 2.1 Stillwater National Wildlife Refuge Relationship to Flyways, Ecoregions, and River Basins


Interior Basins Ecoregion:
Oregon
Idaho
Wyoming
Nevada
Utah
California
Western Hemisphere Flyways:
Pyramid Lake:
River Basins:
Truckee River Basin
Carson River Basin
California
Nevada
Stillwater Refuge Complex:
Fallon National Wildlife Refuge
Stillwater Wildlife Management Area
Stillwater National Wildlife Refuge

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migration also contribute to these off-refuge experiences. The annual Spring Wings Bird Festival, going on its third consecutive year, is advertised in an international directory of birding and nature festivals (National Fish and Wildlife Foundation 1999), thus contributing to the growing demand for national and international birdwatching destinations. Also contributing to its role as a national and international destination is the Lahontan Valley wetland's designation as one of only a handful of internationally-recognized shorebird reserves (Western Hemispheric Shorebird Reserve Network). Further, Stillwater NWR and the Lahontan Valley wetlands as a whole are periodically the subject of articles in nationally-circulated magazines, such as Audubon, Sunset, and Nevada Magazine, touting it's value as a travel destination for all the reasons listed above.

2.2.2 Regional

The Stillwater NWR Complex is situated at the west-central end of the Service's Interior Basin's ecoregion in Region 1 of the Service (Map 2.1). This ecoregion roughly corresponds with the Great Basin and Mojave Desert. The Intermountain West Joint Venture, a component of the North American Waterfowl Management Plan, encompasses much of the Interior Basins ecoregion. As a focus area of the Intermountain West Joint Venture, Stillwater NWR Complex contributes toward achieving the primary goal of the joint venture, which is to "provide for the long-term conservation of wetland-habitats and their associated wildlife" in the Intermountain West (Intermountain West Joint Venture 1995). Another major goal of the joint venture is to restore and maintain migratory bird populations at 1970 levels. Specific population targets and habitat objectives are listed in the Intermountain West Joint Venture Implementation Plan (Intermountain West Joint Venture 1995).

The Stillwater NWR Complex is regionally important to other bird species. For example, Anaho Island NWR contains one of the nation's largest nesting colonies of American white pelicans at 7,000 to 10,000 pairs. White-faced ibis populations are influenced by wetland-habitat conditions throughout the Great Basin. The availability and quality of suitable nesting habitat on Stillwater NWR is important to this population of birds.

Long known in western Nevada for its high-quality waterfowl hunting opportunities, Stillwater NWR and Stillwater WMA is becoming increasingly popular with out-of-state hunters seeking less-crowded hunting conditions. The Stillwater NWR Complex is also enjoying a growing regional recognition for the birdwatching opportunities that can be found there. Of primary interest are the numerous waterfowl, shorebirds, and other waterbirds that breed in the refuge's wetlands or rely on its wetlands during migration. Stillwater NWR has recently been included in a number of state and regional birdwatching and wildlife observation guides, which are sure to add to this reputation. The refuge complex contributes to off-refuge birdwatching experiences as well. One of the high points of birdwatching in western Nevada is the site of a white pelican in a desert surroundings, and these are produced on Anaho Island NWR and fed on Stillwater Marsh and other Lahontan Valley wetlands. Other birds produced on the refuge complex contribute to off-refuge experiences as well. The Stillwater NWR Complex's environmental education program, which grew considerably starting in the early 1990s has been contributing to

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environmental education in schools throughout western Nevada since that time. The program continues to grow.

In addition to the more visible activities associated with wetlands that contribute to a local and regional economy, such as birdwatching, hunting, and general recreation, there are other social benefits that may accrue. Among these benefits, as they relate to the Lahontan Valley wetlands complex, are (1), the role of the wetlands in the Pacific Flyway in terms of its contribution to the quality of waterfowl hunting throughout the flyway and (2), the impact of the wetlands on non-game species of birds. Furthermore, there is an existence value associated with the wetlands complex, as a remnant of ancient Lake Lahontan and the knowledge that the wetlands exist.

2.2.3 Landscape

Stepping down from the Interior Basins ecoregion, the Carson and Truckee River Basins (Maps 1.2 and 2.1) provide the water that flows into the Lahontan Valley wetlands and Pyramid Lake, respectively. The Truckee Canal created a link between the two basins hydrologically, but there are other connections between the two basins. Many of the white pelicans nesting on Anaho Island in Pyramid Lake make daily feeding forays to Stillwater Marsh and other Lahontan Valley wetlands, a distance of roughly 60 miles. The majority of people who visit the Stillwater NWR Complex live within the Truckee-Carson River Basins, including many people from the Reno area, through which the Truckee River flows.

Wetlands in Stillwater NWR, Stillwater WMA, and Fallon NWR are components of the Lahontan Valley wetland ecosystem. Other components include wetlands in the Carson Lake Wildlife Management Area (managed jointly by NDOW and TCID) and Fallon Paiute-Shoshone Reservation, the Carson River, Carson Sink, and various irrigation reservoirs, canals, and drains. The Lahontan Valley wetland ecosystem forms the terminus of the Carson River, which originates in the Sierra Nevadas south of Lake Tahoe. Wetland-habitat in Stillwater NWR and Stillwater WMA contribute toward meeting requirements of Public Law 101-618, one requirement of which is for the Department of the Interior to acquire, in conjunction with the State of Nevada, enough water to sustain a long-term average of 25,000 acres of primary wetland-habitat in four designated areas in the Lahontan Valley. The other two areas are the Carson Lake Wildlife Management Area and the Fallon Paiute-Shoshone Reservation. No other valley-wide goals or objectives exist with respect to conserving wildlife, wetlands or other habitat, or for providing opportunities for wildlife-dependent recreation. The alternatives considered in the Draft EIS were developed in consideration of the management objectives and strategies being considered for the Carson Lake Wildlife Management Area. Also considered is the current status and management of the Carson River, regulating reservoirs, canals, and drains throughout the Lahontan Valley and the wetland-habitat these areas support.

At a landscape level, the public-use program at Stillwater NWR Complex most notably contributes to the hunting opportunities available to local residents. Other local hot spots for hunting include Carson Lake, Humboldt Sink, and several private hunt clubs, all of which provide different types of experiences. Given the increasingly urban component of Fallon and Churchill County, it is anticipated that the Stillwater NWR Complex will become more important as a destination for local residents interested in viewing wildlife and touring natural areas, in addition to continued use of the area by local residents for hunting. The growing environmental education program will also reach more local residents over time.

2.3 EIS STUDY AREA

2.3.1 Geographic and Climatic Setting

The EIS study area, the area in which potential impacts were identified and analyzed in Chapter 4, encompasses the lower reaches of the Carson and Truckee River Basins. The portion of the Carson River Basin included in the study area begins at the upper end of Lahontan Reservoir, near Fort Churchill, and continues downstream to the terminus of the Carson River in the Lahontan Valley and Carson Sink. Carson River flows, recorded just above Lahontan Reservoir since 1912, have averaged about 289,820 acre-feet per year. Flow volumes have varied widely during the period of record, with a high annual flow at Fort Churchill of 804,300 acre-feet (1983 water year) and a low annual flow of 26,300 acre-feet (1977 water year). Lahontan Reservoir is a water-storage facility for the Carson Division of the Newlands Irrigation Project which is located in Churchill County, Nevada. Water from Lahontan Reservoir is conveyed to farmland and wetlands through the lower Carson River and an extensive network of canals and drains, which terminate at the Lahontan Valley wetlands and Carson Sink. Carson River water that is delivered and otherwise conveyed to Carson Division farmland and wetlands is supplemented by Truckee River water (an estimated average of 37,700 acre-feet per year), via the Truckee Canal.

The Carson Desert, or Lahontan Valley as it is more popularly known, is the largest intermountain basin in Nevada. This basin is bounded by several mountain ranges, with peaks ranging from 5,338 to 8,790 feet in elevation. The vast majority of the Carson Desert, about 2,000 square miles (1.3 million acres), is comprised mainly of gently rolling desert shrublands and flat alkali playas. Proportionally, farmland, City of Fallon and associated suburbs, and wetlands in the Lahontan Valley comprise a small component of the basin (roughly 7 percent). The Carson Division of the Newlands Project is situated near the southwestern end of the basin and the Lahontan Valley wetlands lie at the eastern, northeastern, and northern periphery of the Carson Division. An estimated 55,075 acres of water-righted farmland is irrigated each year on average in the Carson Division. The City of Fallon sits roughly in the center of the Carson Division.

When they have water, the Lahontan Valley wetlands are some of the most productive in the western United States. They are unique in that they provide expansive areas of relatively shallow wetland-habitats with waters of varying salinity. The Lahontan Valley wetlands are characterized by shrinking and swelling, both seasonally and annually, as well as over geologic time. This fluctuation creates a diverse Great Basin wetland ecosystem, which encompasses a wide range of wetland-habitat types within a localized area. Within the span of one season, these wetlands can transform from shallow lakes with clear, freshwater, to shallow, brackish marshes with high salt concentrations.

The Lahontan Valley wetland system is comprised of the Carson River and its delta, Carson Lake, Stillwater Marsh, and wetlands on the Fallon Paiute-Shoshone Indian Reservation. Upon completion of the ongoing water-rights acquisition program, a long-term average of 25,000 acres of wetland-habitat will be maintained in Carson Lake, Stillwater Marsh, and the Fallon Paiute-Shoshone Indian Reservation. The Carson Sink is an additional wetland associated with the Carson River, and it is the ultimate terminus of the system. This wetland is not part of the Lahontan Valley wetlands described in Public Law 101-618.

In general, the climate of the Lahontan Valley is arid, summers are hot, and winters are cold. In summer, night temperatures are characteristically cool. The average daytime maximum temperature during July-August, typically the hottest months, is about 91°F and the average daily low is about 52°F. Temperatures in July and August can exceed 100°F. The average daytime low temperature during December-January is about 18°F and the average high is about 46°F. The minimum temperature recorded since 1900 is -25°F and temperatures below 10°F are not uncommon. Annual precipitation ranges from one to nine inches and averages about five inches. An average of about two inches is received during February-May. Annual evaporation of surface water exceeds precipitation by about 12 to 1, due to the desert climate. Lahontan Reservoir, other Newlands Project regulating reservoirs, and the primary wetland areas show evaporative losses of 60 or more inches per year. The long-term average (1940 to 1990) evaporative loss rate for Fallon is 53 inches per year.

The study area also includes the lower Truckee River Basin from where the Truckee Canal leaves the Truckee River (Map 1.2), at the Derby Diversion Dam, downstream to Pyramid Lake. Downstream of the Derby Dam, the Truckee River enters the Pyramid Lake Indian Reservation and then flows north before entering Pyramid Lake. Major features along this stretch include Marble Bluff Dam and Pyramid Lake Fishway which are about three miles upstream of Pyramid Lake, and Numana Dam and Fish Ladder which are located upstream of Marble Bluff Dam.

Anaho Island NWR is a rocky island that rises from the waters of the southeastern portion of Pyramid Lake. From its two prominent center peaks, the terrain slopes gently toward the water's edge through a series of old stranded beaches. Anaho Island is the largest Island in Pyramid Lake. The size of the Island depends on the level of the lake. In 1913 when the refuge was established, the island was 247 acres. Based on a water level elevation in Pyramid Lake of 3,809 feet in July 1997 (USDI 1997), Anaho Island was an estimated 575 acres.

The Truckee Canal conveys Truckee River water from the Derby Diversion Dam to the Lower Carson River Basin. Along the way, water is diverted to supply the Truckee Division of the Newlands Project. About 4,000 acres of water-righted farmland is irrigated each year in the Truckee Division.

2.3.2 Socioeconomic Setting

Historically, farming, ranching, livestock production, and a rural lifestyle have characterized the social and economic environment in the study area. In recent years however, rapid population growth, increased commercial and light industrial development, and the expansion of the Naval

Air Station-Fallon have changed Fallon and Churchill County. Generally, these changes represent a transition toward a more urban lifestyle. Cities and towns within the study area are Fallon, Stillwater, and Hazen (Churchill County); Fernley (Lyon County), and Wadsworth and Nixon (Washoe County). Because the changes that could occur as a result of the alternatives being considered in this Draft EIS would not measurably affect the social and economic resources in the Truckee River Basin, the social and economic study area is limited to the lower Carson River Basin, most of which lies in Churchill County, Nevada.

Communities in the lower Carson River Basin, like much of Nevada, are experiencing population increases at a steady annual rate. Churchill County's population, for example, grew by more than 3 percent annually between 1990 and 1996 (U.S. Bureau of the Census and Nevada State Demographer) and almost 6 percent between 1996 and July 1, 1997 (Nevada Division of Water Planning, March 1998). In 1997, Churchill County's population base was approximately 23,860 residents, which included residents of the Fallon Paiute-Shoshone Indian Reservation. Fallon is the largest city in the county -- in which approximately 35 percent of the County's population reside. Growth is projected to continue at a rate of about 2 percent over the next five years.

More than 95 percent of Churchill County's 3.1 million acres is classified as fourth-class grazing lands or rangelands. Another 355,000 acres remain classified as agricultural. Most of the irrigated agriculture in Churchill County is in the Newlands Irrigation Project. The balance is classified as residential, industrial, and commercial. Expansion of the industrial, commercial, and residential land-use pattern is displacing prior land uses, typically agricultural (irrigated farm lands or grazing lands).

According to a report prepared by the University of Nevada, Reno (Department of Applied Economics and Statistics), the major employers in Churchill County are Federal, State and local governments; the service industry; and wholesale and retail trade. Federal, State and local governments account for nearly one-third of the jobs in the County. According to the Nevada Division of Water Planning (Churchill County Socioeconomic Overview, March 1998 with revisions), the service sector provides about 34 percent of the total jobs in the community. This is followed by wholesale and retail trade with 24 percent of the employment. Agriculture and its associated service sector account for an estimated 8 percent of jobs in the county, while construction provides 7 percent. Mining, manufacturing, transportation and public utilities, finance, insurance and real estate make up the remainder of employment in Churchill County.

2.4 STILLWATER NWR COMPLEX

2.4.1 Ecological Setting

Stillwater NWR, Stillwater WMA, and Fallon NWR are adjoining Federal wildlife areas located approximately six miles northeast of Fallon in Churchill County. They are situated at the southwestern end of the Carson Sink and entirely within the subbasin of Pleistocene Lake Lahontan. The three Federal wildlife areas lack any significant topographic relief, with elevations ranging between a low of about 3,865 feet in the Carson Sink within the Fallon NWR to a high of 4,270 feet at the base of the Stillwater Range in the extreme southeastern portion of Stillwater NWR. In general, substrates on the three Federal wildlife areas are fine-grained, valley bottom sands and silts. Major geographic features within the Federal wildlife areas include numerous playas with highly alkaline sediments, both active and stable dune formations adjacent to the playas, and marshes which receive water from the Carson River and agricultural activities in the Lahontan Valley (Charlet et al 1998).

Being fairly representative of the Lahontan Valley in terms of the habitats encompassed within its borders, the landscape of Stillwater NWR, Stillwater WMA, and Fallon NWR is dominated by gently rolling to flat desert shrublands and flat alkali playas. Desert shrub plant communities on Stillwater NWR, Stillwater WMA, and Fallon NWR typically are made up of plant species that can tolerate moderate to highly alkaline soils and can survive on minimal precipitation (about five inches per year). Three different upland desert shrub community types have been identified on Stillwater NWR, Stillwater WMA, and Fallon NWR: greasewood shrublands, saltbush desert shrublands, and dunes (Map 2.2). The topographic depressions tend to have saline, clayey soils that pond water whereas raised areas tend to have sandy, less saline, more well drained soils. The depressions are the playas that are scattered throughout the upland shrublands.

Although they comprise the smallest amount of area, the basin wetland and riparian areas support the highest diversity of wildlife. The main sources of water enter Stillwater NWR, Stillwater WMA, and Fallon NWR through Newlands Project canals and drains and the Carson River. The lower Carson River within the Stillwater WMA is in degraded condition, suffering from a depleted water supply, heavy livestock grazing, and encroachment by saltcedar and other introduced species. Historically, this riparian area was dominated by cottonwoods and a variety of shrub species.

Deep water, more than four feet, is rare in Stillwater Marsh. This wetland is now characterized by shallow and deep emergent vegetation (such as alkali bulrush, cattails, and hardstem bulrush), vast areas of submergent vegetation (such as horned pond weed and wigeon grass), mudflat habitats, and wet meadow communities around the periphery of some wetland units and monotypic saltcedar communities along the edges of others. The wetlands at the delta of the Carson River (on Fallon NWR) has similar wetland-habitat when it has water, but it typically only contains water every three to four years. Saltcedar is abundant on Fallon NWR.

Anaho Island NWR is in the Pyramid Lake Indian Reservation and is about 30 miles northeast of Reno, Washoe County, and about 60 miles northwest of Stillwater NWR. The island, which has fluctuated in size from 220 to 745 acres in recent history, has fairly gentle slopes near the shoreline, but the topography becomes steep and rocky toward its peak. The island harbors desert shrub communities, including greasewood and winterfat; nonnative annual grass species such as red brome and cheatgrass; and native bunch grasses and forbs such as desert needlegrass and buckwheat (Map 2.3). Closer to the shoreline, vegetation is scant.

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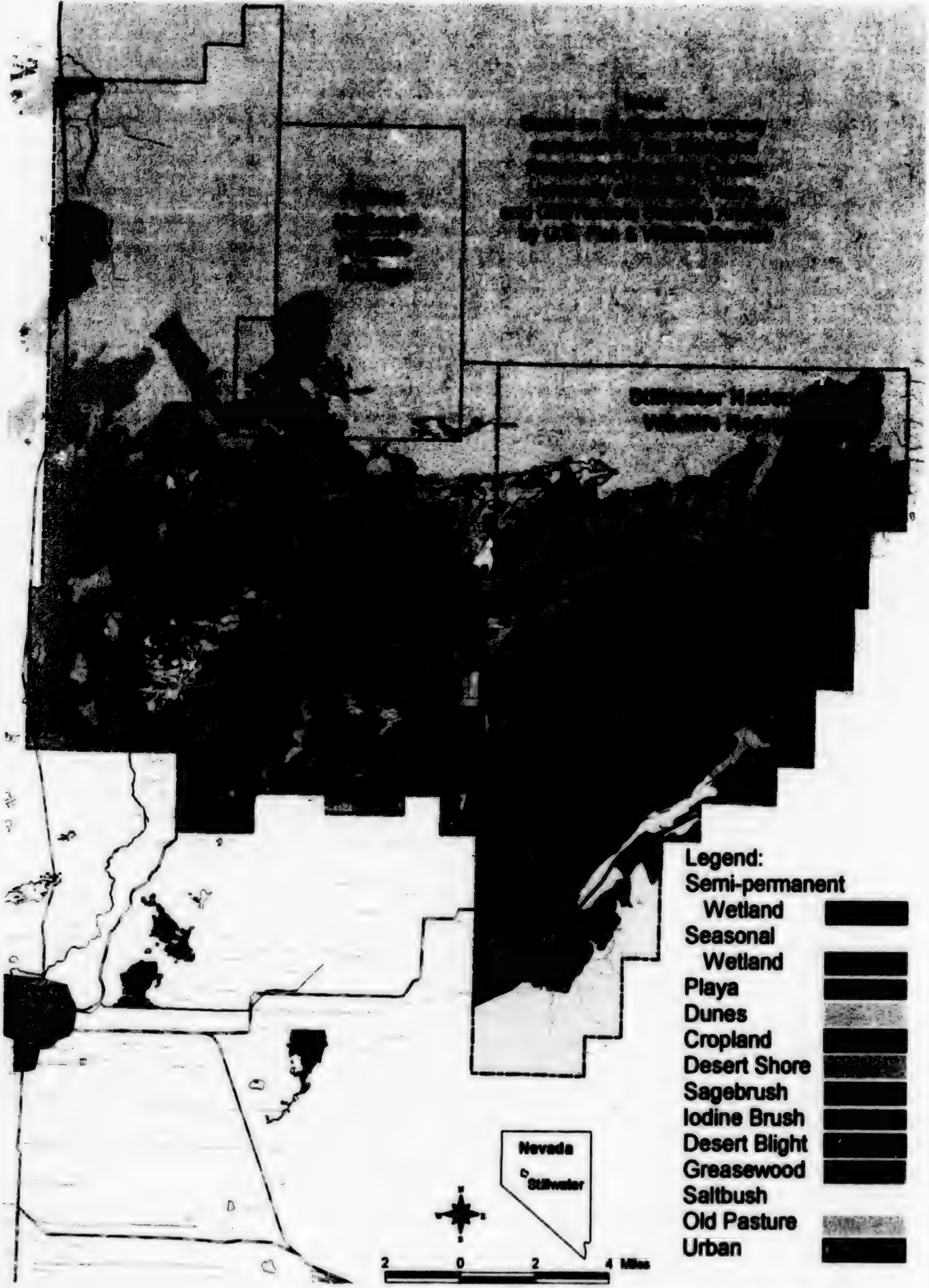
Map 2.2 Stillwater Land Cover



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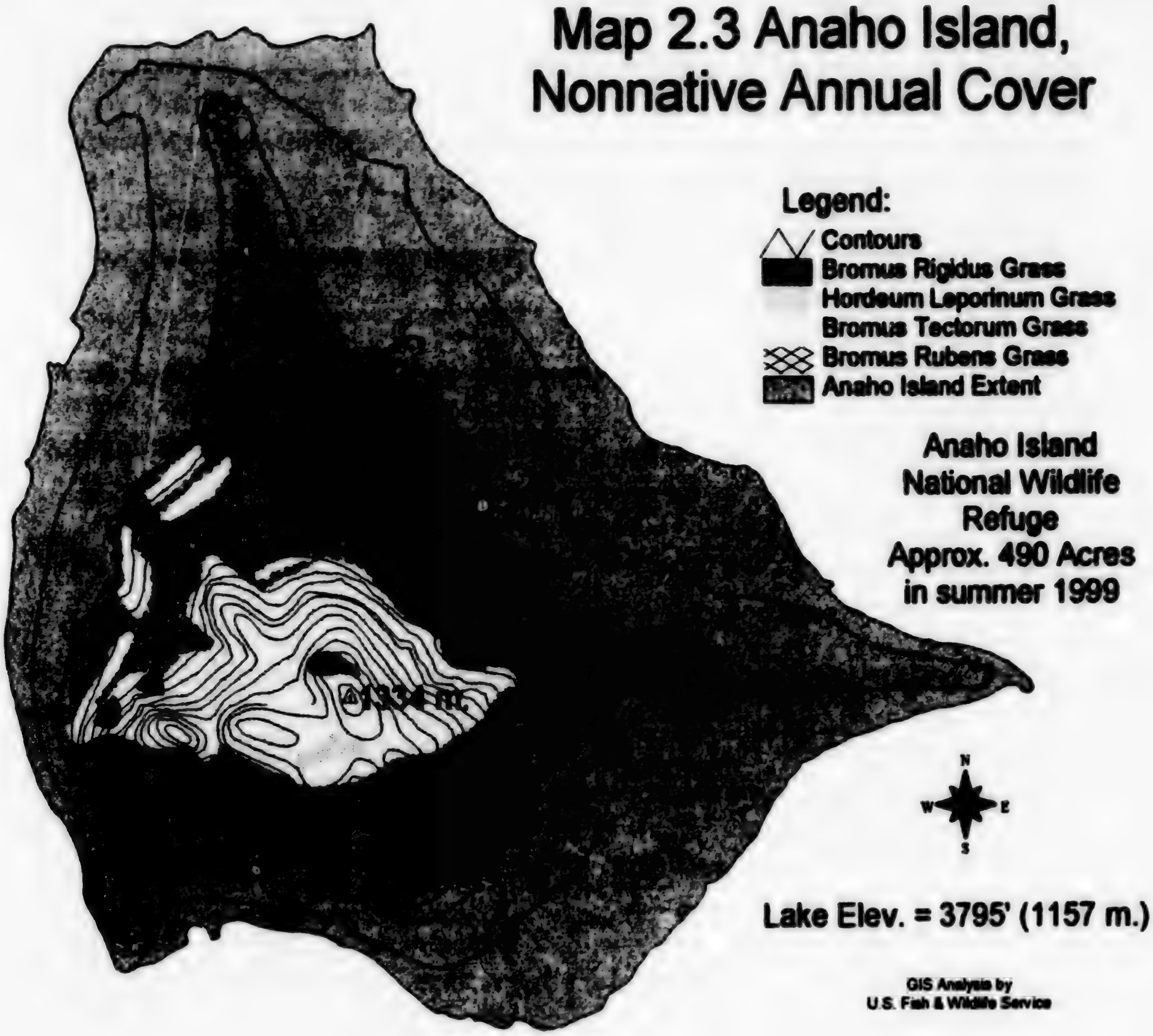
Map 2.3 Anaho Island, Nonnative Annual Cover


Legend:
Contours
Bromus Rigidus Grass
Hordeum Leporinum Grass
Bromus Tectorum Grass
Bromus Rubens Grass
Anaho Island Extent
Anaho Island National Wildlife Refuge Approx. 490 Acres in summer 1999
1334 m.
N
W
E
S
Lake Elev. = 3795' (1157 m.)
GIS Analysis by U.S. Fish & Wildlife Service

2.4.2 Public Use

A variety of public uses occur on Stillwater NWR and WMA. These uses include but are not limited to the six priority public uses of the Refuge System identified in the Refuge System Administration Act, as amended, namely hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Wildlife observation and photography are popular activities, with attention focused primarily in the 80,000-acre Stillwater NWR and its diverse waterfowl and waterbird populations. Spring and fall migrations of waterfowl and shorebirds reach peaks of over 200,000, and a number of heronries furnish opportunity for viewing some of the more showy species. Other favorite areas for observing avian life and are the Indian Lakes portion of the Stillwater WMA, and the Timber Lake area to the north of Indian Lakes (Map 1.3). Timber Lake is currently being surveyed for its rich diversity of passerine (songbird) species, and it offers breeding habitat for herons and night-roosting habitat for bald eagles. The upland areas provide opportunity for viewing shrub reliant

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species such as sage sparrows, loggerhead shrikes, rodents such as kangaroo rats, and a variety of lizards. Mule deer are commonly seen in the agricultural fields located near the entrance to Stillwater NWR, and muskrats are common throughout the canals and in the wetland units. An annual birding festival, Spring Wings, provides opportunity for over 400 participants to enjoy organized tours of not only Stillwater NWR, but a number of other Lahontan Valley birding sites. A focus of this festival is on elevating the national awareness on education and awareness of wetland species and conservation issues.

Waterfowl hunting is a favorite recreational pursuit at Stillwater Marsh in years when sufficient water is available to provide fall and winter habitat for waterfowl. This use accounts for approximately half of the annual visits to Stillwater Marsh. Abundant fall waterfowl support an active hunting program with few restrictions. Boating is currently permitted on all open wetland units any time of the year, but most boating is done to support of waterfowl hunting. Opportunities for hunting other species such as quail, deer, and coyote are currently available in the Stillwater WMA.

Environmental education and interpretation are important on Stillwater NWR. Refuge staff lead tours, conduct school educational outings, and provide assistance to visitors. The program, lacking in the past, has continued to grow over the last ten years as educational methods and materials are acquired and developed. Interpretive panels as well as staff-led talks and tours are currently undergoing extensive design and enhancement. Over 1,000 students and educators from a 150-mile radius have benefitted from Stillwater's current programs.

In years past, fishing rivaled hunting in terms of the number of people partaking in this activity on Stillwater NWR, and a small number of people can still occassionally be found fishing for carp and catfish in some of the canals and wetland units of Stillwater NWR. Likes Lake in the Indian Lakes area is annually stocked with trout by NDOW, which has enabled these small lakes to sustain a fairly well-used seasonal sport fishery.

People also use the area for a variety of uses including camping, swimming, sightseeing, muskrat trapping, and horseback riding. Most of these uses occur in the Indian Lakes area within the Stillwater WMA. Muskrat trapping is done primarily in Stillwater Marsh.

2.4.3 Cultural Resources

Stillwater NWR and Stillwater WMA contain some of the richest cultural resources in the Great Basin. Humans have flocked to Stillwater Marsh for millennia because, as excellent habitat for wildlife, the Stillwater area is an excellent place for people to live.

Cultural resources are physical remains, sites, objects, records, oral testimony, and traditional ways that connect us to our nation's past. Cultural resources include archaeological and historical artifacts, sites, landscapes, plants, animals, sacred locations, and traditional cultural properties that play an important role in the traditional but continuing life of a community. Most of the recorded cultural resources at Stillwater are archaeological sites.

Archaeological evidence shows that human beings have lived in and around Stillwater Marsh for at least 12,000 years. The historic descendants of this legacy are the *Toedokado* or Cattail-eater Northern Paiute of Stillwater Marsh and vicinity. The *Toedokado* occupied an area bounded by the Humboldt Range to the north, Alpine Mountains to the east, Desert Range and south end of the Sand Springs Mountains to the south, and the Truckee and Virginia Ranges and the lower Carson River to the West. The modern descendants of the *Toedokado* are represented by the Fallon Paiute-Shoshone Tribe whose reservation borders are near Stillwater NWR to the east and Stillwater WMA to the north. Cultural resources in the Stillwater area remind us that people have been part of the American wildlife landscape not for a mere 100 years, but for at least 12,000 years.

Toedokado origin myths place Jobs Peak, located in the Stillwater Range, at the center of creation. From there, the first people were dispersed to Stillwater Marsh (among other places) which was filled with water by the tears shed by the Creator because of warring among his children (Fowler 1992). The explorers, settlers, and journalists who came into *Toedokado* territory all remarked on the vibrant Indian population at Stillwater Marsh. The marsh was alive with Indians as much as it was with wildlife and fish. And, archaeological research has shown that the marsh has been a human landscape for thousands of years. Archaeological remains of *Toedokado* culture pervade the soil of every island, peninsula, and dune of the marsh. Even the barren playas have yielded evidence of the people.

The *Toedokado* were year-round residents of the marsh. They were not fleeting nomads who somehow eked out a living in a harsh environment. They understood the complexities of the ecosystem and were able to extract all the necessary food and raw materials to maintain a rich and thriving culture. For *Toedokado* descendants and members of the Fallon Tribe, the archaeological sites, sacred places, plants, and animals of Stillwater Marsh are basic elements of individual and group identity. Thus, the management of the Stillwater NWR and its cultural resources is of particular concern to the Fallon Tribe. As the comprehensive conservation plan compels us to contemplate our interaction with the Stillwater environment today, we must remember that the *Toedokado* and their ancestors have been doing this for millennia.

One of the salient features of Stillwater archaeology is an abundance of human burials (Brooks et al. 1987, Larsen and Kelly 199?). The flood of the mid-1980s revealed more than 4000 human bones representing at least 140 people. Overnight, the number of known archaeological human remains in the Great Basin doubled. It is safe to infer that hundreds more human burials lie just below the surface of greasewood-studded islands and peninsulas of the Stillwater wetlands. The archaeological pattern appears to be that any residential archaeological site may contain one or more human burials. The possibility of encountering human remains almost anywhere in and around the marsh is high. The exposure of burials does not require a massive erosion event like the flood of the mid-1980s. Localized wind or sheet wash erosion occasionally bring bones or a burial to the surface.

2.5 NATURAL ECOLOGICAL CONDITIONS OF THE CARSON DESERT WETLANDS

The "maintenance and restoration of natural biological diversity" purpose of Stillwater NWR, in addition to the emphasis on natural habitat conditions in international treaties and Service policy, prompted an investigation of natural ecological conditions in the Lahontan Valley and other parts of the Carson Desert. This section summarizes these results of this investigation.

The level of detail in the following discussion is higher than preceding discussions, primarily because the subject matter of previous sections is dealt with in more detail in Chapter 4 and nowhere else is there a discussion on natural ecological conditions. This information is directly pertinent to objectives and strategies in the action alternatives of this Draft EIS.

2.5.1 Definitions of Key Concepts

"Natural biological diversity" and the "range of natural conditions" are key concepts of the natural biological diversity purpose of Stillwater NWR. Natural biological diversity is defined as the variety within and among biological communities that evolved in the Carson Desert under geological, evolutionary, and other ecological processes apart from human influence. Biological diversity, which is commonly defined as the variety of life and its processes, can be measured in terms of the number and types of species and biotic communities, and the abundance, distribution, and structure of each, as well as the genetic diversity, structural complexity of vegetation, and diversity of biotic processes (DeLong 1996).

Because of the highly dynamic nature of Great Basin wetland systems, the natural range of ecological conditions is a very important consideration in developing objectives and strategies for restoring natural biological diversity, as opposed to an estimation of the average conditions. Natural conditions cannot be boiled down to a "snap-shot in time." Assessing the natural range of ecological conditions should help managers avoid what has been termed a "museum" approach to management (Parsons et al. 1986). For this reason, a 95-year period was used to assess natural conditions, enough time to account for conditions that can reasonably be foreseen during the planning horizon of the Stillwater NWR Complex Comprehensive Conservation Plan (15 years) and beyond.

Managing for natural conditions does not necessarily eliminate active management. In fact, excluding active management could hamper efforts to approximate natural conditions. Although human actions and developments tend to reduce the degree of naturalness, the term natural more importantly refers to *a set of conditions* that would exist under the operation of natural processes, rather than referring to the *absence of human intervention*. Because the hydrology is so highly altered and will not return to a naturally-functioning state, and because a whole host of other reasons including the introduction of nonnative species and contaminants, active management will be a necessary part of approximating natural conditions. To address questions concerning long-term changes in climate and prediction of conditions that existed long ago, the conceptual

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model focused on estimating the range of natural conditions that would have occurred from 1912 to 1996 if humans had no influence on the wetland ecosystem.

2.5.2 Natural Functioning and Composition of the Carson Desert Wetlands

The Lahontan Valley wetlands are part of the Carson Desert wetland ecosystem, which includes Carson Sink in addition to the Lahontan Valley wetlands. The six major hydrologic components of the Carson Desert wetland ecosystem are: Carson River, Carson Lake, Stillwater Marsh, Carson Sink (historically known as North Carson Lake), numerous scattered alkali playas and seep ponds not associated with the Carson River system, and groundwater. All of the components of the Carson Desert wetland ecosystem, except the scattered playas and seep ponds, are integrally linked by water originating from the Carson River. Water from the Humboldt Basin rarely entered the Carson Sink under natural conditions (before the opening in the ridge at the lower end of the Humboldt Basin was enlarged).

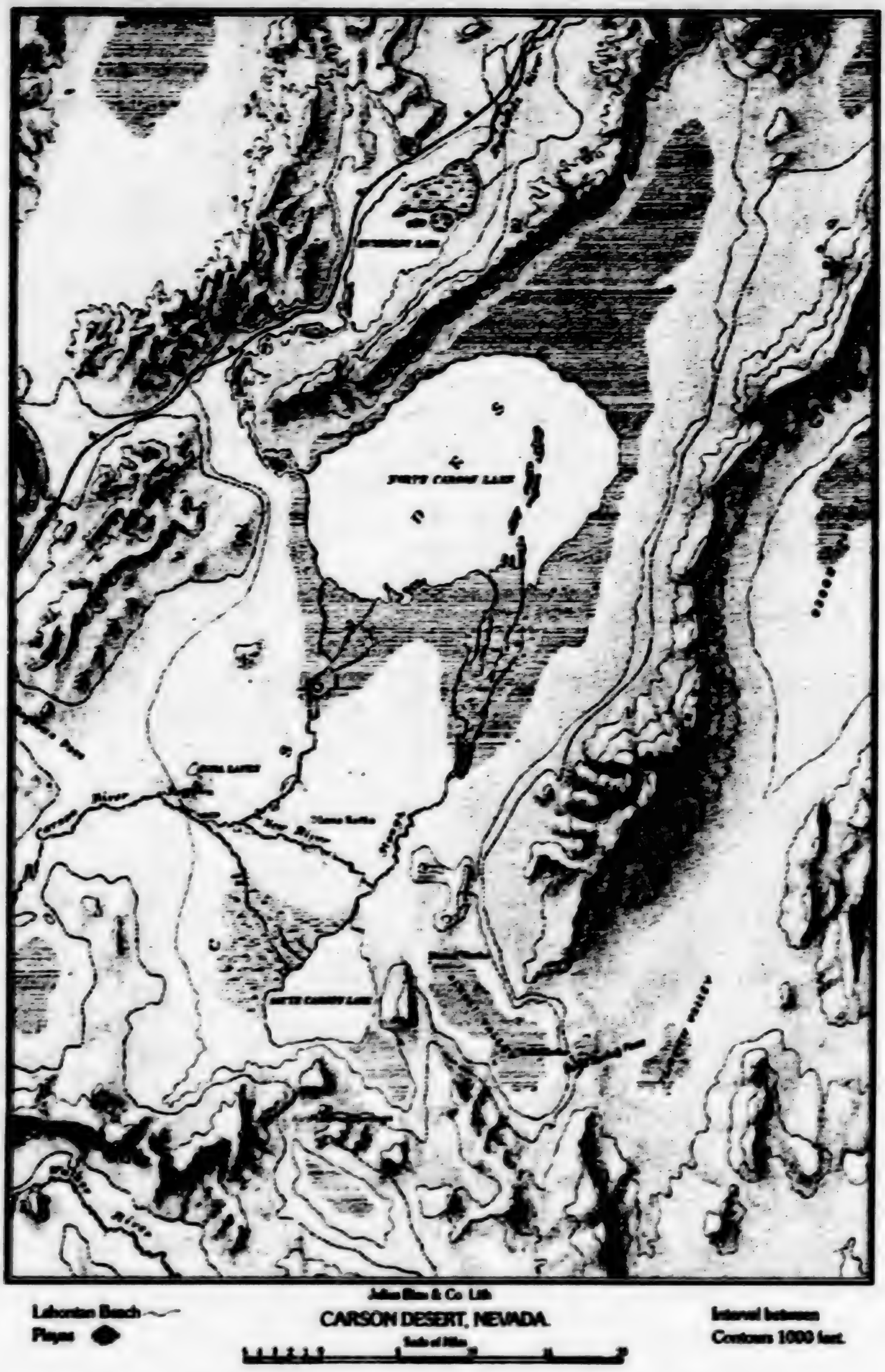
2.5.2.1 Hydrology

The main factors that affected wetland ecology in the Carson Desert were the annual volume of inflow, timing of inflow, flow route of the Carson River through the system of wetlands, and evaporation rates. These and other factors are discussed in the following sections.

2.5.2.1.1 Flow Routes of Carson River

Historically, runoff from the Sierra Nevadas (via the Carson River) constituted the primary inflow of water to the Lahontan Valley wetlands. The Carson River was more dynamic prior to construction of the Newlands Irrigation Project; the river channel frequently changed paths during flood flows (Maurer et al. 1994). Russell (1885) reported that prior to 1862, the Carson River flowed only into South Carson Lake (Map 2.4). In the Spring of 1862, high water divided the flow into two separate branches flowing east toward South Carson Lake, and northeast toward the Stillwater Marsh.

Although the actual river channel changed course over time, in recent history (during the mid to late 1800s), the river took three routes on its way to the Carson Sink (formerly called North Carson Lake), the ultimate terminus of the Carson River. At times water flowed first into Carson Lake (formerly called South Carson Lake), which overflowed nearly every year into Stillwater Slough, which flowed into Stillwater Marsh (Map 2.4; Russell 1885). In most years under this flow pattern, Stillwater Marsh overflowed into Carson Sink during the peak runoff period. At other times, the Carson River flowed directly into Stillwater Marsh, bypassing Carson Lake, and then into Carson Sink. Other periods saw the Carson River bypass Carson Lake and Stillwater Marsh, and directly flow into Carson Sink. Undoubtedly peak runoff of the Carson River resulted in several channels carrying water through the Lahontan Valley into two or three of the subbasins. Over the course of geologic time, the Carson River took thousands of paths through these three different routes.



Map 2.4. Reproduction of an early map showing the Carson Desert wetlands before development (1880's). The "South Carson Lake" is now known as Carson Lake; "North Carson Lake" is now known as Carson Sink, and the vast delta of the Carson River as it enters "North Carson Lake" is now known as Stillwater Marsh. (Illustration was published in 1885 as Plate VII by I.C. Russell in U.S. Geological Survey Monograph 11, A Report on Ancient Lake Lahontan.)

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Stillwater Marsh appears to have acted as a delta to the former North Carson Lake, except that the chain of sand dunes that formed along the south shore of the lake interrupted the flow. This may have aided in the development of the marsh. As a consequence of the sand dune chain, the Carson River at times likely formed a marsh similar to Stillwater Marsh further to the west. At the western-most edge of the dunes, in the area of Battleground Point and Pelican Island, and to the west, the Carson River could flow uninterrupted into North Carson Lake. A dune blockade would not have formed the same type of marsh as was formed to the east, and the delta wetlands may have been similar to that formed at the delta entering South Carson Lake.

2.5.2.1.2 Wetland Topography and Shape

Wetland geomorphology ranged from Carson Lake, which was a relatively deep circular lake, and Carson Sink, a relatively shallow circular lake, to Stillwater Marsh, a highly complex wetland with shallow to deep areas, areas of highly intermixed habitats, and vast expanses of other habitats. Carson Lake was about ten feet deep when full, at which time 80 percent was over four feet deep. Carson Sink generally was less than four feet deep. During the late 1800s and early 1900s, a relatively deep channel meandered through Stillwater Marsh, creating deep-water areas and providing a path for Carson River water to flow into the Carson Sink. Although the channels running through the marsh and most of the upper end of Stillwater Marsh appear to have been deeper than four feet, the majority of the marsh was less than two feet deep when Stillwater Marsh was at full pool.

The complexity of wetland shorelines can have considerable influence on wetland communities (Wetzel 1975). Shoreline complexity is a function of the length of the wetland shoreline relative to the amount of wetted surface of the wetland and can be expressed using an index in which a perfect circle has an index of 1.0. Carson Lake, when at full-pool, has a simple shape near that of a circle (an index of 1.6). This is similar to the Carson Sink, which had a shoreline complexity varying between about 1.4 and 2.0. Stillwater Marsh, on the other hand, had a highly complex shoreline, ranging from about 3.6 up to 13.8 or more, depending on location in the marsh. Marshes that formed to the west would similarly had complex shorelines.

2.5.2.1.3 Annual and Seasonal Volumes of Inflow

In the absence of any diversions or water control structures during the period of record, an estimated average of about 410,000 acre-feet would have flowed past Fort Churchill into the Lahontan Valley as surface runoff (Kerley et al. 1993). The flow volumes under these natural conditions would have ranged from an estimated low of 90,000 acre-feet (1977 water year) to an estimated high of about 940,000 acre-feet (1983 water year). In 80 percent of the years, about 200,000 to 700,000 acre-feet of water would have flowed into the Lahontan Valley, sufficient enough to produce annual peak acreages of wetland-habitat of roughly 60,000 to 200,000 acres.

Stemming from the average conditions identified in Kerley et al. (1993), a model was developed as a tool to estimate the natural range in hydrologic conditions in the Carson Desert wetland ecosystem (DeLong 1997). Variability is a key element of Great Basin ecology. Although specfic numbers are presented, the results of the model are intended to portray general patterns and trends. The basis of the model is monthly flows that occurred in the Carson River during 1912-1996, using U.S. Geological Survey flow gauge records. For each year during this period, unobstructed flows were determined by accounting for the diversions that have occurred from the river, as done in Kerlety et al. (1993). After ordering all of the water-years from lowest volume to highest unobstructed volumes, five representative years were identified:

- 1994 (lower 10-percentile) - 190,000 acre-feet
- 1920 (lower quartile) - 270,000 acre-feet
- 1941 (median) - 385,000 acre-feet
- 1993 (upper quartile) - 480,000 acre-feet
- 1977 (upper 10-percentile) - 690,000 acre-feet

Under natural, unobstructed conditions, Carson River water flow would have been less than 385,000 acre-feet in half the years and more in the other half. Centered around the midpoint of 385,000 acre-feet, about half the years would have seen an annual flow volume of 270,000 to 480,000 acre-feet of water. Carson River flow into the Lahontan Valley would have been less than 270,000 acre-feet in 25 percent of the years and would have been above 480,000 acre-feet in another 25 percent of the years. Similarly, 10 percent of the years would have seen less than 190,000 acre-feet and another 10 percent would have seen more than 690,000 acre-feet.

Carson River runoff during April-June consistently accounted for about 40 to 60 percent of the total annual flow (Table 2.1, Figure 2.1). This does not take into account the irregular floods that can occur any time between November and June when rainstorms at high elevations hit the snowpack. In many years, runoff prior to April was sufficient to refill Carson Lake and/or Stillwater Marsh and subsequent April-June runoff flowed through these wetlands into Carson Sink. However, April-June flows would have been sufficient in most years to overflow the banks of the lower Carson River and the deltas leading into Carson Lake, Stillwater Marsh, and/or Carson Sink. This created a considerable amount of seasonal wetland-habitat that is not produced to any large extent today. An estimate of the seasonal pattern of wetland-habitat acreage that would have occurred in Stillwater Marsh under various annual inflow volumes is depicted in Figure 2.2.

Table 2.1. Proportional amount of the annual volume of water that would have flowed into the Lahontan Valley under natural conditions for five representative water years.

		Percent of Flow-Volume by Season				
Representative Water-year		Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total
lower 10%	(190,000 AF)	13	69	8	10	100
lower 25%	(270,000 AF)	13	68	11	8	100
median	(385,000 AF)	13	68	13	6	100
upper 25%	(480,000 AF)	16	70	12	2	100
upper 10%	(690,000 AF)	27	57	11	5	100

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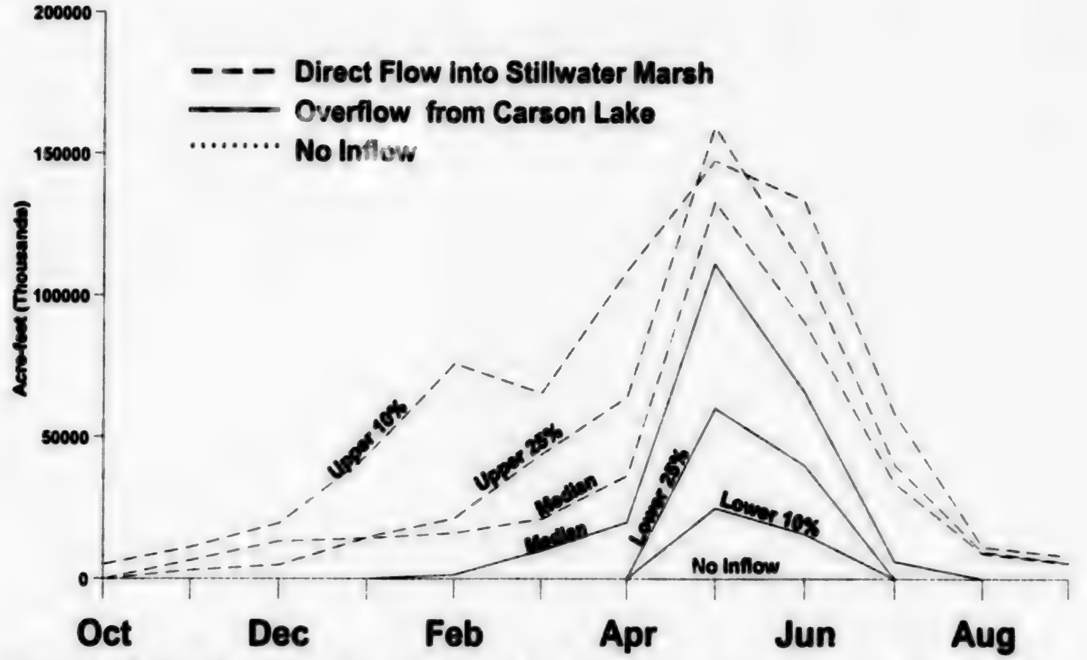

Figure 2.1. Estimated unrestricted flow of the Carson River into Stillwater Marsh, illustrating the range in variability from year to year.

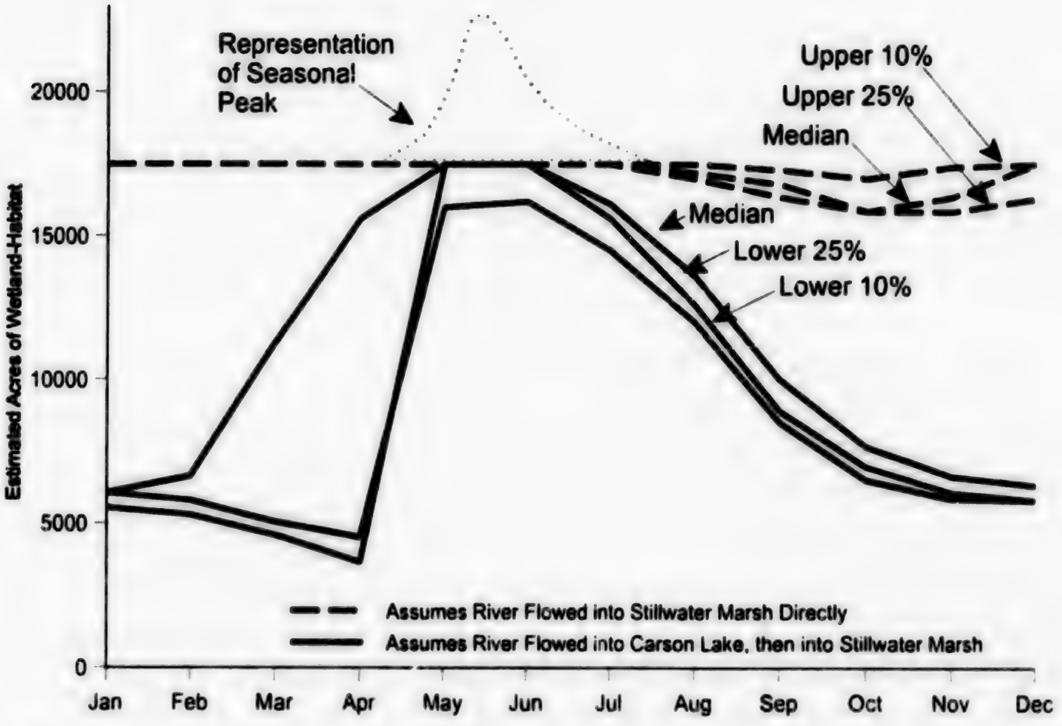

Figure 2.2. Estimated natural seasonal wetland-habitat acreage in Stillwater Marsh under six different scenarios to illustrate the variability that would have occurred among years. Acreages are rough estimates and are primarily included to illustrate seasonal patterns. Included is a representation of the potential seasonal peak acreage, of which the conceptual model used to develop this graph was not designed to estimate. Not shown is the situation when the Carson River would have bypassed the Stillwater Marsh for extended periods, at which time the marsh would have remained dry.

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Spring flow volumes flushed the wetland-habitats of accumulated salts and other dissolved solids. At times when the Carson River flowed into Carson Lake and/or Stillwater Marsh, water volumes were likely sufficient in most years to maintain most of Stillwater Marsh as a relatively freshwater system. The concentration of total dissolved solids of inflowing water was an estimated average of 170 milligrams per liter (Kerley et al. 1993), and was estimated to have ranged from roughly 50 to 350 milligrams per liter. (This compares with current concentrations of 1,170 milligrams per liter in drainwater inflows, which until recently were the primary water source outside of spill-years.) The amount of water flowing into Stillwater Marsh in most years was much higher than the amount of water needed to offset evaporation and transpiration from plants (evapotranspiration). Using estimates provided in Kerley et al. (1993), the average amount of water flowing into Stillwater Marsh would have been in the neighborhood of 15 to 20 acre-feet/acre/year or more. This assumes an average inflow of 270,000 acre-feet and an average of 15,000 acres of wetland habitat in Stillwater Marsh. Given this inflow volume and an estimated evapotranspiration rate of 5 acre-feet/acre/year, two-thirds to three quarters of the water entering Stillwater Marsh would have flowed through the marsh and out into the Carson Sink.

Episodic flooding, which once sent voluminous flows into the marshes of Lahontan Valley, had considerable influence on vegetative structure in the wetlands by changing the course of the Carson River, scouring, flushing accumulated salts, and matting or uprooting vegetation. This was an important factor in shaping wildlife habitat in the wetlands. On average, there has been one flood in ten years on the Carson River that has exceeded 15,000 cubic-feet per second at the peak of flow. The maximum recorded peak flow was 30,000 cubic-feet per second in 1955 (Glancy and Katzer 1975). Peak flow during flood events has exceeded 5,000 cubic-feet per second in about one of four years. (For comparative purposes, the maximum amount of water that can safely be released and spilled from Lahontan Reservoir is about 1,800 cubic-feet per second.) Flood flows of several thousand to 10,000 cubic-feet per second or more was an irregular, but fairly common occurrence in Stillwater Marsh, as compared to present conditions when the maximum inflow rate is 450 cubic-feet per second from several points of entry (and this flow rate rarely occurs). Floods can occur anytime between November and early June.

At the time when Carson River inflow decreased (July-September), evapotranspiration was at its highest. During July-September, about 10 to 15 percent of the annual flow of the Carson River would have entered the Lahontan Valley wetlands. However, in many years when the Carson River flowed directly into Stillwater Marsh, there was enough water flowing into the marsh in all but the driest years to keep it full, given an estimated 25,000 to 50,000 acre-feet of inflow during this period in most years (Figure 2.1). In other years, especially when Carson River flowed into Carson Lake first, Stillwater Marsh would have shrunk during this period. This would have left shallower, more saline marsh habitats. In areas continuing to receive Carson River inflow, concentrations of total dissolved solids would have remained in the low hundreds of milligrams per liter. However, in backwater areas of Stillwater Marsh and in the Carson Sink, total dissolved solid concentrations would have exceeded 10,000 milligrams per liter, and likely approached 100,000 milligrams per liter. This resulted in a wide range of water conditions in the Carson Desert wetland ecosystem.

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Even in the driest of years, a considerable amount of wetland-habitat would have remained in the Lahontan Valley through fall and winter. Inflow during October-December accounted for about 5 to 10 percent of the annual inflow into the Lahontan Valley, and in January-March, inflow would have consistently been about 10 to 20 percent in most nonflood years.

2.5.2.2 Other Ecological Processes

No other ecological process had as much effect on the Lahontan Valley wetland ecosystem as the hydrologic functioning of the marsh. Second to hydrology, grazing by muskrats was likely a significant factor influencing wetland vegetation, especially in the marshes. However, little is known about the muskrat ecology prior to the introduction of nonnative muskrats to the Lahontan Valley wetlands. Some evidence indicates that, prior to muskrats being introduced from Tule Lake NWR, California (USFWS 1950), which had been stocked with muskrats from the north-central United States, that the local population were burrowers rather than mound builders (Fowler 1992). This may have limited the amount of grazing in the interior of the marsh prior to the introduction of muskrats originating from north-central United States. When populations are high, muskrats can maintain open areas within extensive stands of cattail and hardstem bulrush. Under natural conditions, muskrat populations are very dynamic, meaning that at times their influence on vegetation is small and at other times, very pronounced.

Disease was another factor that had a major influence on marsh ecology. When populations are high, muskrats are susceptible to disease. Whether native populations were susceptible to the same diseases is unknown. In some years, botulism likely took a toll on waterfowl populations migrating through the Lahontan Valley wetlands during the fall. However, under natural conditions, water conditions were different from today and there was significantly more wetland-habitat, so the extent of mortality caused by botulism is unclear.

Although browsing by mule deer may have been high at times in riparian areas, grazing by large ungulates (a hoofed, grazing mammal) had minimal influence on wetland plant communities before the introduction of livestock. The only native ungulates that occurred over the past 1,000 years in the Lahontan Valley were mule deer, bighorn sheep, and pronghorn. Mule deer were the only resident ungulate of the basin and they are primarily browsers; when they graze, it is primarily on forbs rather than grasses. Other herbivores that may have had varying influence on vegetation include cottontails, voles, and a variety of invertebrates. Whether beaver were native to the area is unclear.

Predation of nests by ravens, magpies, coyotes, and other wildlife was prevalent under natural conditions, although it is possible that they did not impact production of waterbirds and other birds to the extent they do today. For instance, raven populations appear to have been smaller in the past, wetland-habitat was much more extensive, and vegetation was more conducive to nesting birds.

Fire was likely a rare event in the Lahontan Valley wetlands under natural conditions, and therefore had minimal influence on vegetation, although the local Paiutes regularly burned the marsh and possibly the riparian corridors as well.

2.5.2.3 Wetland Vegetation Communities

The seasonal and annual fluctuations in water conditions resulting from differing volumes of inflow, timing of inflow, shifting flow patterns, and high rates of evapotranspiration created a variety of wetland-habitats, including braided river channels, closed oxbows, floodplain meadows, ephemeral marshes along the Carson River, and larger perennial and ephemeral marshes and lakes associated with the terminus of the Carson River, such as Carson Lake, Stillwater Marsh, and Carson Sink. Water ranged from freshwater in the river and many of the marshes to very saline in some parts of the marsh and the Carson Sink, which produced a great variety of vegetation. This diversity of habitats attracted a wide range of animal species, including vast populations of ducks, pelicans, wading birds, shorebirds, muskrats, fish, and invertebrates, and a large variety of passerine birds and small mammals. The following discussion focuses on historic descriptions of major habitat types (riparian systems, marsh habitats, and terminal basins), changes in these habitats over time, and estimated wildlife use of wetland-habitats prior to Newlands Project development.

2.5.2.3.1 Riparian Systems

Branches of the Carson River were characterized by tree and tall shrub species including cottonwood and willows, with a mixed shrub and grass understory (Russell 1885). Changes in channel location, related to flow corridor and flow intensity, left oxbow lakes and associated riparian wetlands in old channels. Following a change in channel location, earlier successional habitats such as mixed meadow grasses and willows would have been the primary vegetation types. After a period of time at a given channel location, late successional cottonwood stands would have developed. Based on estimated dynamics of the river channel, it is unlikely that large, gallery cottonwood stands were abundant as J. C. Fremont (1845), J. H. Simpson (1876), and Bailey (1898) describe the river channel as marked by a line of green cottonwoods, of which previous channel locations were delineated by remnant stands of cottonwoods (Russell 1885).

Relative salinity levels and soil types likely played a role in riparian vegetation development, as J. C. Fremont describes the Stillwater Marsh outlet to the Carson Sink as "having banks eight to ten feet high with willow growth" (Spence and Jackson 1973). As shown on an 1885 map of the Lahontan Valley (Map 2.4), two channels passed through the sand dunes at the northern end of the Stillwater Marsh, likely characterized by higher salinity and sandy soils. Cottonwoods would not become established along this riparian corridor under these conditions. It is uncertain whether the willow vegetative community is representative of an early or late successional habitat; however, the sandy soils in this area provide conditions for frequent changing of channel location which is more likely the case in this area.

While trees and tall shrubs characterize the previous riparian corridors, Stillwater Slough appears to have been more variable in vegetative coverage. Dequille (1963; as cited in Kerley et al. 1993) recounted a description of Stillwater Slough as "60 feet wide, with vertical banks eight- to ten feet high, having grass along the stream, and cutting through the barren sandy plain with only scattered clumps of sage and greasewood". Conversely, the place name for Stillwater Slough used by the *Toedokado* was "tule-flowing" which suggests emergent growth throughout the channel (Fowler 1992). In all likelihood, the slough contained elements of several different vegetation communities ranging from willow, to grass, to emergent, to unvegetated depending on flow amount and duration. Considering this was a popular fishing spot for the *Toedokado* and that the banks were eight to 10 feet high, this channel was presumably more static, and thus, less likely to change location. It is uncertain how the flood of 1862 and resulting division of the Carson River into multiple channels affected vegetation in this riparian system, as one of the new channels flowed directly into Stillwater Slough (Bailey 1862).

Active river channels had extensive associated floodplains. These floodplains, which are evidenced by the soils that developed under them (Dollarhide 1975), appear to have included a variety of grass species as well as sedges and rushes. Some grass species that are rare today in the area, such as Great Basin wild rye, likely formed extensive stands in suitable soils (Young 1996).

In summary, riparian vegetation communities were variable with cottonwood and willow stands common along the lower reaches of the Carson River; upland shrub, grasses, and emergent vegetation along the Stillwater Slough; and willows with few other plant species located at the outlet of Stillwater Marsh to the Carson Sink. Other habitats included wooded oxbow lakes with grasses, and emergent submergent vegetation; floodplain meadows where the river channel overflowed its banks; and large grass meadow deltas where the channel flowed into the marsh system. Most vegetative species would have been freshwater adapted with virtually no information available to predict species compositions within riparian plant communities. However, there is little question that riparian habitats were much more extensive historically and that a wider diversity of vegetative species and habitat types were associated with this system.

2.5.2.3.2 Marsh Systems

Although the Carson Sink appears to have retained marsh vegetation in most years, two primary marsh complexes have been described in the Lahontan Valley; Carson Lake and the Stillwater Marsh. Prior to 1862, Carson Lake appears to have been a deeper water habitat, with maximum depth approaching ten feet and only a thin ring of marsh vegetation (described as tule margin 30 to 40 yards wide) maintained around the edge during most years (Bailey 1898). The flood of 1862 split the channel resulting in considerably less water entering the lake. By 1883, much of the lake appeared to be a swamp, this suggests that water depths had dropped to a level supporting emergent vegetation throughout much of the lake (Russell 1885). Kerley et al. (1993) proposed that, prior to 1862, based on the size of the cottonwoods described at the mouth of the Carson River, the deep lake system was in place for at least 20 years. It is this long-term variability, in conjunction with annual hydrologic periodicity that maintained the high productivity indicative of the marsh environment.

Stillwater Marsh appears to have functioned as a single elongated basin that was very complex due to the countless islands and peninsulas. Water flowed from Stillwater Slough, through the maze of watercourses in Stillwater Marsh, to the Carson Sink. Plant communities varied depending on water depth and salinity levels. During times when the Carson River or Stillwater Slough flowed into Stillwater Marsh, the large influx of water would have maintained a

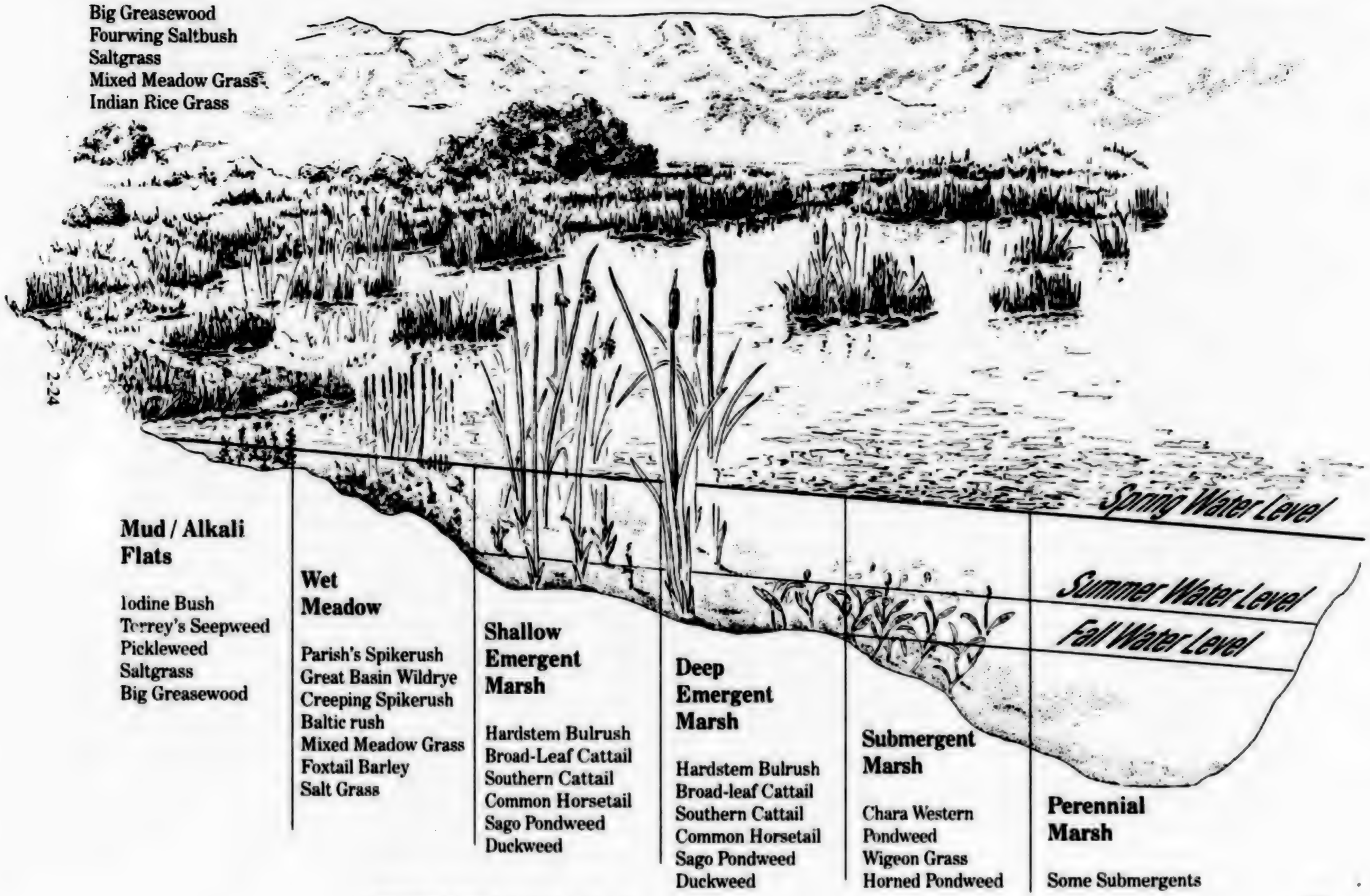

Figure 2.3.
Estimated Natural Plant Distribution in Wetland Habitats of Stillwater Marsh, Nevada.

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freshwater system, throughout the flow channel to the outlet into the Carson Sink. Salinity levels through the marsh marsh would have increased with increasing distance from these flow channels. Timing and amount of water inflow were variable in this system with marsh permanency determined by flow route, snowpack in the Sierra Nevadas, and timing of inflow. Estimates show that marsh water levels would have remained fairly constant through the year when water entered the Stillwater Marsh directly. Conversely, when water flowed through Carson Lake first, high evaporation rates in summer, at a time when inflow was at its lowest, would have reduced much of the wetland surface area in Stillwater Marsh. When the Carson River flowed into the Carson Sink directly, Stillwater Marsh would have been much more seasonal, when at least some water flowed into the marsh during peak flow, or would have dried completely. This would have resulted in considerable vegetative variation, both within and among years.

There are few detailed accounts of the historic Stillwater Marsh available. However, two very different marshes were described through the mid- to late-1800s, depicting drought and flood cycles in relation to water flow patterns, which was likely common to the Lahontan Valley historically. During an 1845 expedition, Fremont describes Stillwater marsh as "a large marsh surrounded by sandhills with extremely disagreeable waters" (Spence and Jackson 1973). This may have been either a low water year or a period when the river channel bypassed flow to Stillwater marsh, resulting in high salt concentrations from evaporative drawdown. However, Bailey (1898) portrayed the Stillwater Marsh as "half shallow lake, half tule swamp which extends for 20 miles along the valley bottom."

Habitat types would have been similar to those discussed in Section 4.4.1. However, the distribution and species occupying these types would have been somewhat different than suggested in this section and a few additional communities would have been present. Several plant communities known to have occurred historically have either been displaced by nonnative vegetation or can no longer survive under increased salt concentrations present in the marsh today. Even in the late 1950s, two freshwater submergent vegetation species (coontail and water milfoil) were common in early refuge vegetation surveys (Service annual fall surveys, 1959 to present). Recent inventories did not reveal the presence of either plant community (Donohue and Baumgartner 1995, Bundy et al. 1996); however, the species were located in isolated locations of the Lahontan Valley.

While still common in the Stillwater Marsh, three emergent vegetation species (hardstem bulrush, cattail, and alkali bulrush) have switched levels of dominance within the deep and shallow emergent habitat types. The historic marsh (around 1900) likely had an approximate proportional coverage of 33:27:40 (hardstem bulrush, cattail, and alkali bulrush, respectively), while a 1952 survey completed by D. Marshall revealed a ratio of 14:66:20 (Fowler 1992, Giles 1953, USFWS 1952). This is about a 200 percent increase in cattail abundance over a 50-year period with a 1,000 acre increase in emergent vegetation coverage. Similarly, moist soil habitats would have likely been comprised of dock, Torrey's seepweed, and kochia. All of these species are still present, but exotics such as five-hook bassia now dominate this habitat type (Bundy et al. 1996). Additionally, curly dock (an introduced species) has displaced the native dock species which appears to have occurred around the turn of the century (Fowler 1992). Vegetative species thought to have occurred among habitat types around 1900 are included in Table 2.2.

Table 2.2. Representative plant associations thought to have occurred prior to 1900 among transitional upland, wetland, and riparian habitats, by relative coverage and frequency of occurrence.

	Transitional Upland Habitat	**Basin-Wetland Habitats**					**Riparian Habitat**
Community Type	**Upland**	**Mud/Alkali Flat**	**Wet Meadow**	**Shallow Emergent**	**Deep Emergent**	**Submergent**	**Riparian**
Community Dominant	**Dry - Moist**	**Moist - 6"**	**Moist - 12"**	**6' - 24"**	**12" - 36"**	**12" - 48"**	**0" - 48"**
Tree and tall Shrub Communities							
Fremont Cottonwood	Absent	Absent	Absent	Absent	Absent	Absent	**Common**
Fremont Cottonwood/Great Basin Wildrye	Absent	Absent	Absent	Absent	Absent	Absent	**Common**
Red Willow	Absent	Absent	Absent	Absent	Absent	Absent	**Common**
Sandbar Willow	Absent	Absent	Absent	Absent	Absent	Absent	**Common**
Wetland Shrub Communities							
Big Greasewood	**Common**	Rare	Absent	Absent	Absent	Absent	Present
Big Greasewood - Dotted Dalea	**Common**	Absent	Absent	Absent	Absent	Absent	Rare
Big Greasewood - Torrey's Seepweed	**Common**	Rare	Absent	Absent	Absent	Absent	Rare
Iodine Bush	**Common**	Present	Absent	Absent	Absent	Absent	Absent
Torrey's Seepweed	**Common**	Present	Absent	Absent	Absent	Absent	Absent
Transitional Upland Shrub Communities							
Big Sagebrush	**Common**	Absent	Absent	Absent	Absent	Absent	**Common**
Quailbush	**Common**	Absent	Absent	Absent	Absent	Absent	**Common**
Rubber Rabbitbrush - Dune Horsebrush	**Common**	Absent	Absent	Absent	Absent	Absent	Present
Emergent Communities							
Alkali Bulrush	Absent	Present	Present	**Common**	Present	Absent	Absent
Alkali Bulrush - Narrow-Leaf Cattail	Absent	Rare	Present	**Common**	**Common**	Absent	Absent
Broad-Leaf Cattail	Absent	Absent	Rare	Present	**Common**	Rare	Present
Common Reed	Absent	Rare	Rare	**Common**	Rare	Absent	Present
Common Three-Square	Absent	Present	Present	**Common**	Present	Absent	Absent
Hardstem Bulrush	Absent	Absent	Absent	Present	**Common**	Present	**Common**
Smooth Scouring Rush	Absent	Absent	Rare	Present	**Common**	Rare	**Common**
Narrow-Leaf Cattail	Absent	Rare	Rare	Present	**Common**	Rare	Present
Narrow-Leaf Cattail - Hardstem Bulrush	Absent	Absent	Absent	Present	**Common**	Rare	Present
Wet Meadow Communities							
Baltic Rush	Present	Present	**Common**	Absent	Absent	Absent	**Common**
Baltic rush - Creeping Spikerush	Absent	Present	**Common**	Absent	Absent	Absent	**Common**
Creeping Spikerush	Absent	Present	**Common**	Absent	Absent	Absent	**Common**
Creeping Spikerush - Water Hyssop	Absent	Rare	**Common**	Absent	Absent	Absent	**Common**
Parish's Spikerush	Unknown	Unknown	**Common**	Absent	Absent	Absent	**Common**

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	Transitional Upland Habitat	Basin-Wetland Habitats					Riparian Habitat
Community Type	**Upland**	**Mud/Alkali Flat**	**Wet Meadow**	**Shallow Emergent**	**Deep Emergent**	**Submergent**	**Riparian**
Community Dominant	**Dry - Moist**	**Moist - 6"**	**Moist - 12"**	**6" - 24"**	**12" - 36"**	**12" - 48"**	**0" - 48"**
Grass Communities							
Alkali Muhly	Common	Absent	Rare	Absent	Absent	Absent	Absent
Baltic rush - Inland Saltgrass	Present	Rare	Common	Absent	Absent	Absent	Present
Great Basin Wildrye	Present	Rare	Rare	Absent	Absent	Absent	Common
Inland Saltgrass	Common	Present	Present	Absent	Absent	Absent	Present
Mixed Meadow Grass	Present	Rare	Common	Absent	Absent	Absent	Common
Submerged Aquatic Communities							
Chara	Absent	Absent	Absent	Rare	Absent	Common	Rare
Coontail	Absent	Absent	Rare	Rare	Rare	Common	Present
Duckweed	Absent	Absent	Present	Present	Common	Present	Common
Horned Pondweed	Absent	Absent	Absent	Present	Present	Common	Present
Long-leaved pondweed	Absent	Absent	Absent	Present	Present	Common	Present
Narrow-leaf Water Plaintain	Absent	Rare	Common	Present	Rare	Present	Present
Sago Pondweed	Absent	Absent	Absent	Present	Present	Common	Present
Water Hyssop	Absent	Rare	Common	Present	Rare	Present	Present
Water Milfoil	Absent	Absent	Absent	Rare	Present	Common	Present
Western Pondweed	Absent	Absent	Absent	Present	Present	Common	Present
Wigeongrass	Absent	Absent	Absent	Rare	Rare	Common	Rare
Herbaceous Communities							
Dock	Present	Common	Present	Absent	Absent	Absent	Common
Devil's Beggartick	Common	Present	Absent	Absent	Absent	Absent	Present
Pickleweed	Absent	Common	Rare	Absent	Absent	Absent	Rare

Common - plant community would be indicative of habitat type. found in all years with high coverage
Present - Plant community would be found in habitat type but not in all years or in high coverage
Rare - Plant community might be present in habitat type but found in few years with low coverage
Absent - Plant community would not be found in habitat type (although representative species might under certain conditions)

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Overall, the historic marshes were extremely dynamic systems, with the different areas (Stillwater Marsh, Carson Lake, and the Carson Sink) experiencing long-term drought and flooding based on the flow pattern of the Carson River. Vegetation patterns would have varied accordingly with Carson Lake experiencing periods of high water where the majority of the lake would not support vegetation followed by drought where a large expanse would have been covered by emergent and submergent vegetation. The Stillwater Marsh would have varied from periods where extensive emergent and submergent vegetation stands would have been dominant, to periods where considerable seasonal wetland-habitat would have remained only during spring. These long-term cycles were likely the driving force behind the evolution of the Lahontan Valley wetlands.

2.5.2.3.3 Terminal Basins (The Carson Sink)

Vegetation in the Carson Sink was likely the most variable of the wetland basins, due to highly fluctuating water levesl and wide ranges in salinity. Bailey (1898) described eight separate habitat zones during a period when water flowed directly to the sink including:

- Slope soils washed of salt and soda with other than alkaline plants.
- Flat valley bottoms loaded with salt and soda, baked mud, where rain settles and devoid of plants.
- Flat bottom of the valley with scattered low shrubs of Sarcobatus (greasewood), Atriplex (shadscale), Suaeda (seepweed), and Tetradymia (dune horsebrush).
- Extensive sand dunes.
- Clay mounds with Sarcobatus near lowest mud flats.
- Extensive shallow lake/tule swamp of the valley bottom.
- Saltgrass/sedges/tules associated with the lake/swamp.
- Narrow and broken line of cottonwoods along the Carson River.

This depicts the variability in salinity with sedges and tules likely located near the mouth of the Carson River, shrubs located along uplands and areas periodically desicated during low flow years, and areas "devoid of plants" where salts accumulate and settle.

Conversely, Russell (1885) suggests that the Carson Sink was dry during 1862 as all water in the Carson River was diverted to South Carson Lake. This shrinking and swelling of the sink would have created conditions for a variety of plants adapted to different salinity levels and flooding tolerances. Species such as the sedges described by Bailey (1898) can only survive in freshwater environments and thus, were likely restricted to areas near the Carson River delta where freshwater flow was maintained. Species including tules, saltgrass, cattails, and alkali bulrush have higher salinity tolerance and would probably have extended for a longer distance from the delta. As salinity levels began exceeding 20,000 parts per million, the vast majority of vegetative species would not have survived, leaving vast expanses of open, shallow lake. This level (20,000 parts per million) would have been exceeded in most years when water was primarily diverted to other areas or as a previously hydrated Carson Sink began drying.

Although droughts have been of longer duration over the last century, periodic flooding still creates a wide mosaic of vegetation. Sperry (1929), described the river delta and southwest corner of the sink as having a mix of alkali bulrush, cattail, spikerush, sago pondweed, and horned pondweed. While these species are more tolerant of fresher water (less than10,000 parts per million), the old shoreline was marked by iodinebush and pickleweed which are adapted to highly saline environments. (Suitable conditions for iodinebush and pickleweed in the sink are created when salts are left behind as water in the sink evaporates and the wetted area shrinks.) It is interesting to note that most of the same species described by the early explorers, still exist throughout the Carson Sink today. The sedges are no longer present; however, various grasses, tules, cattails and spikerush now abound throughout the Carson River delta and the southwest portion of the Carson Sink after several years of flooding.

2.5.2.4 Wetland Associated Wildlife

With a few exceptions, most of the wildlife species that inhabited the historic marsh are present today. The primary difference is the extent to which they occur. Based on archaeological evidence and past explorer's notes, mink, river otter, and mussels were once prevalent throughout the marsh (Simpson 1876, Russell 1885, Sperry 1929, Fowler 1992, Kerley et al. 1993). All are indicative of a freshwater regime with mink and otter keying in on fish as a food source. This suggests that deeper and fresher water habitats were maintained in the Lahontan Valley wetlands, with abundant fish populations. The historic marsh likely supported large populations of tui chub, Tahoe sucker, and possibly Lahontan cutthroat trout (Fowler 1992, Kerley et al. 1993). This observation is substantiated by early reports of "piles of fish lying about drying" (Simpson 1876) and Indians carrying "several fine strings of fish" (Dequille 1963).

The following discussion focuses on species groups, with the best available historic literature used to estimate the historic abundance of selected native, marsh associated species. While actual numbers are not available, relative population size can be indexed using relative species proportions in archaeological remains combined with firsthand observations and accounts. Species presumed to have changed significantly in abundance are included in Table 2.3.

2.5.2.4.1 Birds

Marsh bird species were abundant and diverse with most of the species present today represented in archaeological data (Livingston 1988, Fowler 1992). Changes in the use of Lahontan Valley by two species, common loon and sandhill crane, may be most representative of long-term habitat changes from historic conditions. Evidence of both species have been found at archaeological sites but have since become rare visitors to the marsh. Loons commonly inhabit deep open water areas while sandhill cranes, as well as white-fronted geese, are associated with wet meadows. The change in composition and coverage by these two habitat types has likely led to the suspected decreases in these species

Table 2.3. Wetland-associated wildlife populations estimated to have been altered from natural population levels, habitats frequented, and possible explanations for this change.

Species[1]	**Habitat Frequented**	**Change from Estimated Historic**	**Possible Reasons for Population Change**
Invertebrates			
Brine flies	Highly saline wetlands	Large Increase	Reduction in freshwater flows
Brine shrimp	Highly saline wetlands	Large increase	Reduction in freshwater flows
Mussel (anodonta)	Freshwater lakes and rivers	Large decrease	Loss of freshwater input
Snails	Lakes/permanent water habitat	Decrease	Reduction in permanent water habitats
Fish			
Lahontan Tui Chub	Lakes, rivers, and other permanent water habitats	Decrease	Introduction of exotic species, loss of permanent water
Tahoe sucker	Rivers	Extirpated	Loss of freshwater input
Lahontan cutthroat trout	Rivers	Extirpated	Loss of freshwater input
European carp	All flooded habitats	Introduced (Abundant)	Introduced, wide tolerance for salinity and introduction
Mosquito fish	All flooded habitats	Introduced (Abundant)	Introduction for mosquito control
Birds			
White-faced ibis	Emergent and shallow habitats. Agricultural lands.	Increase	Flood-irrigation
Long-billed curlew	Upland and shallow water habitats	Decrease	Unknown
American white pelican	Permanent water habitats/open islands	Decrease	Loss of breeding and feeding habitat
Canvasback	Submergent vegetation	Decrease	Less submergent vegetation, factors outside refuge
Common Loon	Deep Open Water	Large Decrease	Loss of deep open water habitat
Sandhill Crane	Wet Meadow	Large Decrease	Reduction in amount and composition of wet meadow habitat
White-fronted goose	Shallow/Meadow habitats	Decrease	Loss of wet meadow habitat, factors outside refuge
Common Raven	Marsh edges/Uplands	Large Increase	Introduction of dump sites, road kills, agriculture, among others
European Starling	Riparian/Agricultural	Introduced (Common)	Introduced, aggressive competitor for nest cavities
House Sparrow	Residential/Agricultural/Riparian	Introduced (Common)	Introduced, aggressive competitor for nest cavities
Mammals			
Mink	Emergent and other permanent water habitat	Large Decrease	Loss of freshwater and fish populations
River Otter	Rivers and associated river delta	Extirpated	Loss of freshwater and fish populations
Beaver	River	possibly introduced, common	
Coyote	Uplands/marsh edges	Increase	Extirpation of wolves and alternate food sources

[1] The listed species are those for which historic literature is available. This table is not a complete listing of affected species.

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numbers and suggests that the range of water depths in the present marsh is not representative of historic conditions.

Waterfowl assemblages have changed somewhat in composition; however, overall numbers were likely similar to those that now occur during periods of high water. While exact numbers are not available from historic literature, archaeological remains suggest that several dabbling duck, diving duck, goose, and swan species were present. It would appear that deeper water associated species such as canvasback, redheads, ruddy ducks, goldeneye, surf scoter, and lesser scaup were more abundant than at present, likely due to more deep water habitats; however, dabbling ducks (such as mallards, pintail, green-winged teal, gadwall, and shovelers, comprised the majority of the Cattail-eater diet (Livingston 1988). Surf scoter were mentioned in several historic reports (Livingston 1988, Raven and Elston 1989, Fowler 1992) but are an infrequent visitor to the present-day marsh, likely for similar reasons as the common loon's more recent absence. White-fronted geese and trumpeter swans were also likely more abundant historically (Fowler 1992); however, trumpeter swan declines at the marsh are probably more related to decreases in continental populations.

Very little information about historic populations and species composition of shorebirds is available. It is assumed that population parameters were similar to what occurs at present, although there is at least some indication that long-billed curlew were more abundant historically (Fowler 1992). Reasons for this are not clear but it may be related to the reduced wet meadow habitat and the change in plant species composition in adjacent upland habitats.

Similarly, historic data are lacking on most other waterbird species with a few exceptions. American white pelicans were likely more abundant historically as the colony on Pelican Island (within Fallon NWR, near the Carson River delta) was considered a place to collect eggs and young sometime during the middle 1800s (Fowler 1992). A small colony has formed infrequently on Pelican Island and other small islands in the Carson Sink through the past century during high water years only (Refuge Files).

Species that have apparently benefitted from changes to the natural system include the common raven and white-faced ibis. Information on historic occurrence of ravens are scant, but from reviewing the literature, it can be estimated as having been low. Grayson (1985), found 11 specimens in a cave which suggests several were in this area; however, this is an upland site located away from the marsh and it is uncertain whether birds were collected at the marsh or in the Stillwater Mountains. Bailey (1898) completed an inventory of bird species observed during a spring trip from Stillwater to Ione (100 miles east of Fallon). His list did not include the common raven. For comparison, a 1996 inventory of Stillwater NWR revealed 112 common ravens in the core wetland area in early June (Stillwater NWR nest survey data).

White-faced ibis have likely become more abundant as a consequence of agricultural development (Fowler 1992). A slow increase in ibis abundance was observed from the early 1900s to the 1950s with most observed individuals feeding on newly flooded agricultural fields. This trend is also related to the abundance of nesting sites (e.g., flooded cattail and hardstem bulrush patches) so variations in population size probably varied considerably over the past 50 years.

2.5.2.4.2 Mammals

Most of the animal bones and other parts found in archaeological remains are from a variety of smaller species of mammals including mice, voles, kangaroo rats, muskrats, mink, river otters, badgers, and rabbits (Schmitt 1988, Raven and Elston 1989). Larger species including coyotes, mule deer, and bighorn sheep were less common in these remains, most of which were found at marsh sites near the base of the Stillwater Mountains. It is unlikely that deer and sheep were common throughout the marsh during most of the year, but apparently were abundant in the nearby mountain ranges (Raven and Elston 1988). The described assemblages were likely more abundant and diverse than those at present (Bailey 1898, Schmitt 1988, Raven and Elston 1989, Fowler 1992).

Large predators were also more abundant around the marsh. Bailey (1898) suggests that lynx were common in the area of north Carson Lake (Stillwater Marsh) and Raven and Elston (1989) found wolf and coyote remains at archaeological sites. Wolves and lynx have long since been extirpated from the Stillwater Marsh; however, coyotes appear to be more abundant at present, possibly due to the absence of these larger predators. It is uncertain whether historic descriptions of lynx refer to bobcat as common names have changed through history. Kit fox and mountain lion have been recently observed in the marsh (although few and infrequently) and it is interesting to note that few historic references to these species exist. Bailey (1898) made inquiries about the abundance of kit fox and found that no one in the valley had ever heard of it.

Wetland specific mammalian species included muskrat, mink, raccoon, and river otter (Schmitt 1988, Raven and Elston 1989, Fowler 1992). All of these species have been found at archaeological sites. River otter no longer exist in the present-day marsh and a relatively new addition, beaver, have become established in the system. When consulted about the historic presence of beaver, the response given by Wuzzie George of the Fallon Paiute-Shoshone Tribe was "he don't belong here" (Fowler 1992). Additional inquiries suggest that the subspecies of muskrat was also different as Wuzzie George had no idea what the large muskrat mounds in the emergent vegetation zones were (Fowler 1992). It is likely that the original, bank-dwelling species was displaced by transplanting muskrat during 1949 following a wide scale muskrat die-off.

2.5.2.4.3 Fish

While several fish species have been documented in archaeological remains, only four were likely common in the Stillwater Marsh system (Tui chub, Lahontan red shiner, Lahontan speckled dace, and Tahoe sucker; Greenspan 1988). Even in the historic marsh, Lahontan cutthroat trout and mountain whitefish would likely not survive, although under certain conditions it is possible that the cutthroat made its way to the lower Carson River and associated wetlands. While data on relative population levels are not available, it is assumed that the tui chub and Tahoe sucker were more abundant during the late 1800s. Tui chub are thought to have declined while the Tahoe sucker is no longer present due to decreases in amount of permanent, open water habitat, reduced water quality, and the introduction of European carp, mosquito fish, and various species of gamefish. Because no recent inventories for Lahontan red shiner or

Lahontan speckled dace have been conducted, it is uncertain whether these species are still present.

2.5.2.4.4 Invertebrates

Several accounts of large populations of freshwater mussels and snails have been offered in the historic literature. Bailey (1898) describes the shoreline of Carson Lake as "covered with mussel shells." Simpson (1876) also reports large numbers of mussels along the Carson Lake shoreline while Sperry (1929) states that "clams are common and snails and insect life abundant" in reference to the Stillwater Marsh. Snails, mussels, and insects were considered common food sources for the *Toedokado* (Drews 1988, Fowler 1992). While snails are still quite common within the Lahontan Valley landscape, freshwater mussels have all but disappeared, presumably related to less fresh and/or permanent water.

Some evidence suggests that brine flies and brine shrimp have increased in abundance from historic conditions. Wuzzie George collected brine flies from Soda Lake (the only place that she was aware that they occurred during her childhood) which were "scooped up from windrows along the shoreline . . . and . . . boiled into a soup" (Fowler 1992). Brine flies have been recently sampled throughout Stillwater Marsh habitats with brine shrimp commonly found during spring, among the scattered alkali playas (Bundy 1996). Increased salinity throughout the wetland complex has likely led to this result. Historic information on the abundance of other invertebrate species has not been found.

2.5.3 Other Habitats and Associated Wildlife

Although the wetlands are a central focus of Stillwater NWR, Stillwater WMA, and Fallon NWR, other habitats on the refuges and wildlife management area, representative of the Carson Desert include greasewood, mixed desert shrub communities, and sand dunes. Most of the historic literature focused on the wetland areas and no historic accounts capable of supporting abundance estimates in upland communities could be found. It is likely that little change has occurred within these habitats over the past few centuries other than geographic location relative to wetland dynamics and changes to the shrub community composition relative to livestock grazing pressure and the introduction of cheatgrass and other nonnative plants, and possibly off-road vehicle use.

Shrub community composition among upland habitats has likely changed little over the past few centuries. Up to 6,500 years before present, it would appear that sagebrush was a key component of the Lahontan Valley upland system (Thomas 1985). After this period, very little sagebrush pollen appeared in any of the archaeological sites, with greasewood and shadscale becoming strongly dominant across the landscape. The largest estimated change to the system in the recent past was the composition of the understory vegetation such as the various grass species common to the system.

Fourteen different greasewood communities were identified in a 1997 vegetation inventory (Charlet 1998), indicating that diversity within the greasewood vegetation type is still quite high under present conditions. Prior to the introduction of livestock, a bunchgrass understory may

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have been extensive in some communities (Fowler 1992). For example, Indian ricegrass was likely abundant in some areas of the Stillwater NWR Complex, based on historic accounts of Indian ricegrass collection by the *Toedokado* (Fowler 1992). Because of the close relationship between ricegrass and kangaroo rats, several species of kangaroo rats were likely abundant as referenced by the four species of kangaroo rat remains discovered in a cave (Thomas 1985). Today, bunchgrasses in greasewood communities are rare with cheatgrass forming the most common understory vegetation type. Cheatgrass was introduced to the United States in the late 1800s (Mack 1986).

The sand dune ecosystem is unique and adds to the biological diversity of the area. Several species of beetles and other insects can only be found in the sand dunes, two species of which may be endemic to the Stillwater dunes (Rust 1998). The source of sand appears to be the Carson River, which carried sand down from the Sierras, and distributed it throughout an alluvial fan along the Carson River delta. No information is available concerning this historic process and it is possible that other processes contributed to sand dune development. A study should be initiated to determine the source and locations of natural formative processes to ensure that we are maintaining this valuable resource within refuge boundaries.

Wildlife information is equally lacking except for analysis of the archaeological records from selected sites (Thomas 1985, Raven and Elston 1988, Fowler 1992). Results of cave content analyses brought several interesting wildlife trends to view (Thomas 1985). For example, sage grouse remains were unearthed at this site suggesting that the vegetation composition in the surrounding lower slopes of the mountain ranges was different historically. Additionally, remains of prehistoric horses, camels, and even bison were unearthed, raising at least some question to the theory that large ungulates had little contribution to upland vegetation community formation. There is considerable question about the relative age of these remains and it is likely that most of this evidence is dated prior to 5,000 to 10,000 years before present (Thomas 1985, Burkhardt 1996).

Considering the loss of these large grazers, it is more likely that small mammals have had more influence on shaping the natural upland system prior to the introduction of livestock in the mid- to late-1800s. The vast majority of archaeological remains and historic accounts suggest that black-tailed jackrabbits and small mammals, including kangaroo rats, pocket gophers, white-tailed antelope ground squirrels, and desert woodrat, were the most abundant mammals in the historic upland system (Bailey 1898, Thomas 1985, Schmidt 1988, Fowler 1992). This group would appear to have been much more abundant and diverse during presettlement times, which makes sense considering the estimated diversity of understories of most upland shrub communities and the reliance of several species of small mammals on grass seed. Some species of kangaroo rats cache seeds from Indian ricegrass, which likely maintained a wider distribution before the introduction of livestock grazing.

Accounts of other wildlife species are almost nonexistent, leaving little information to develop estimates of the historic upland wildlife community. Rather than attempt to do this, it is probably best to assume that similar to wetlands, upland communities were likely more diverse than at present, and that livestock grazing has had the greatest influence on upland vegetation community structure over the past century.

CHAPTER 3
ALTERNATIVES

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CHAPTER 3
ALTERNATIVES

3.1 INTRODUCTION

The purpose of comprehensive conservation planning at the Stillwater NWR Complex is to develop the best possible plan for achieving the purposes for which each refuge was established, and to delineate a boundary for Stillwater NWR that would be most conducive to achieving Stillwater NWR purposes. As in making any decision, a key element in developing and selecting the best possible approach is to evaluate a reasonable range of options before deciding on which approach to use. In fact, the National Environmental Policy Act (NEPA), under which this environmental impact statement is being prepared, requires that a reasonable range of alternatives be rigorously explored and evaluated for all major Federal actions.

Each alternative in this Draft EIS consists of a boundary-revision option for Stillwater NWR, goals for managing each refuge in the complex, objectives to achieve these goals, strategies to accomplish objectives, and a monitoring program to track progress in implementing strategies and achieving objectives and goals. The Service's preferred alternative (Alternative C) describes the goals, objectives, and strategies that would be incorporated into a comprehensive conservation plan for Stillwater NWR if this alternative were selected for implementation. It also identifies the Service's preferred boundary-revision for Stillwater NWR.

This chapter starts with an description of the alternative development process, including a discussion of factors and criteria that were considered in developing the alternatives. Following this discussion is a detailed description of each of the alternatives, including mitigation. Also presented in this chapter is a brief discussion of the alternatives considered but not studied in detail. The major headings in this chapter are as follows:

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3.2 ALTERNATIVE DEVELOPMENT PROCESS

Comprehensive conservation planning at the Stillwater NWR Complex integrated the processes of delineating a boundary revision for Stillwater NWR and developing a comprehensive conservation plan for the Stillwater NWR Complex, as well as the NEPA process required for both processes. NEPA and Service policy require that alternative management approaches and alternative boundary revisions, and their potential consequences be examined before a comprehensive conservation plan and boundary revision are implemented. Alternatives were developed to address statutory and policy requirements governing refuge management as well as other scoping issues.

In the context of this Draft EIS, an alternative is one of several possible approaches to revising the boundary of Stillwater NWR and for managing the Stillwater NWR Complex to achieve refuge purposes and the Refuge System mission. With respect to management of the Stillwater NWR Complex, each alternative identifies a different approach to managing populations and habitat of fish, wildlife, and plants; recreation, education, and interpretation; cultural resources; facilities; and law enforcement; and for administering the complex. Each alternative contains refuge goals, objectives, strategies, and a monitoring program. Although some of the goals, objectives, and strategies are the same among different alternatives, each alternative takes a different approach overall.

Identifying mitigation measures is a required component of alternatives. Mitigation of environmental impacts is an integral component of a comprehensive conservation plan. One of the purposes of such a plan is to resolve environmental problems to improve the quality of the environment on refuges. However, through the process of restoring and enhancing a refuge's environment under any given management approach, adverse impacts could result to resources that are not a focus of that particular approach. Adverse impacts could also occur on off-refuge resources and economies. Thus, in addition to management approaches designed to improve the quality of the refuge environments, other mitigation measures are identified where appropriate. Mitigation measures are defined as actions taken to minimize, avoid, or eliminate significant adverse impacts on the affected environment from proposed management activities.

3.2.1 Sources of Direction

Alternative boundary revisions and management approaches were shaped by a number of factors, including legal requirements of refuge management, management philosophies, existing plans, ecological conditions, and other issues identified during scoping. The direction of refuge management can differ, depending on which of these factors receives the highest priority and how each particular factor is viewed and interpreted.

A priority system has been spelled out in laws and executive orders for the Service with respect to managing the Stillwater NWR Complex. This priority system guided the development of the alternatives for this Draft EIS. The focus of the comprehensive conservation plan, in order of priority, would be to:

1. Conserve fish, wildlife, plants, and their habitat in the manner specifically identified in the purposes of Stillwater NWR, Fallon NWR, and Anaho Island NWR, as well as the Refuge System Administration Act, as amended, and other management authorities;

2. Facilitate opportunities for compatible wildlife-dependent recreational activities; and

3. Resolve other issues identified during scoping.

The Stillwater NWR boundary-revision effort focused on delineating alternative boundaries that would, in order of priority:

1. Contribute toward the achievement of the purposes of Stillwater NWR and provisions of subsection 206(a) of Public Law 101-618, which addresses the maintenance of a long-term average of 25,000 acres of primary wetland-habitat in designated Lahontan Valley wetland areas; and

2. Resolve other issues identified during scoping.

This section summarizes the legal and policy requirements, international treaties and other agreements, and existing plans and programs that govern refuge management.

The following laws, executive orders, policy, international treaties, plans, and other documents are those that provide direction (targets) for refuge management. There are many other laws and executive orders that provide additional guidance for managing national wildlife refuges, a compilation of these can be found in Appendix A.

3.2.1.1 Legal and Policy Requirements of Refuge Management

One of the major objectives of comprehensive conservation planning is to ensure that management of refuges reflects Service policy, Refuge System mission, and purposes for which individual refuges were established (USFWS 1995). Management direction for any given national wildlife refuge, expressed in goal statements, is primarily determined by its purposes as defined in the refuge's establishing authority (either in legislation or executive order). It is further clarified and delineated by the Refuge System mission and other provisions of the Refuge System Administration Act, as amended, other legislation, executive orders, Service policy, and international treaties.

Ensuring that goals accurately reflect the management direction of refuge purposes and other legal authorities is important because goals are stepped down to objectives, which are further stepped down to the strategies that are carried out on the ground. If goals do not accurately

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reflect the management direction spelled out in legal authorities, on-the-ground management stemming from these goals will not reflect this direction either. Likewise, expanding the scope of refuge goals to include issues and resources that are outside the purposes for which the refuge was established could, for example, result in refuge management proceeding in a different direction than is identified in the establishing authorities. In addition to reviewing them during the development of refuge goals, the following laws, executive orders, and Service policy were also considered during the development of objectives, strategies, and alternative boundaries.

3.2.1.1.1 Laws and Executive Orders Governing all National Wildlife Refuges

There are several laws and executive orders that directly pertain to refuge management. The principal Federal laws affecting refuge planning and management are summarized in Appendix A. Regulations developed to guide implementation of applicable laws are codified under Title 50 of the U.S. Code of Federal Regulations (50 CFR). Provisions of some of these are highlighted below.

The Refuge System Administration Act is the primary law governing management of national wildlife refuges. The act was amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge System Improvement Act). One of the main provisions of the Refuge System Improvement Act is that it clearly defined the conservation of fish, wildlife, and plants as the overarching mission of the Refuge System. It requires the the Service to ensure that the biological integrity and diversity, and environmental health of the Refuge System are maintained.

The **dominant-use** mandate under which national wildlife refuges are managed (i.e., wildlife first) means that public uses are not managed in the same way as Federal lands that are under a **multiple-use** mandate, such as lands managed by the U.S. Bureau of Land Management and the U.S. Forest Service.

In recognizing that the conservation mission of the Refuge System is being facilitated by providing people with opportunities to participate in compatible wildlife-dependent recreation on refuges, the Refuge System Improvement Act provides for the continued use of refuges by hunters, anglers, birdwatchers, and other wildlife enthusiasts. The Refuge System Improvement Act identified hunting, fishing, wildlife observation and photography, and environmental education and interpretation as the priority public uses of refuges when they are shown to be compatible with refuge purposes and the Refuge System mission. The Refuge System Improvement Act requires that comprehensive conservation plans be completed for all refuges within a 15-year period, and requires that refuges be managed according to these plans. The act also requires public involvement in the development of the plans.

Although the Refuge System Improvement Act encourages wildlife-dependent recreation on refuges and highlights the benefits that this has to the conservation mission of the Refuge System, the law also recognizes that recreational uses on refuges, if not properly managed, can detract from this mission. As such, the Refuge System Improvement Act requires that all uses, including wildlife-dependent recreational uses, must be shown to be compatible with refuge purposes and the Refuge System mission before they can be allowed on a particular refuge. Compatibility determinations are to be based on sound professional judgement, which means determinations must be consistent with principles of fish and wildlife management, available science and resources, and applicable laws. Other laws and executive orders are summarized in Appendix A.

3.2.1.1.2 Service Policy

The Fish and Wildlife Service Manual (Service Manual) contains Service policy on managing national wildlife refuges. Because it addresses all aspects of refuge management, no attempt is made here to provide a comprehensive overview of all aspects of refuge management. Of primary importance to comprehensive conservation planning on refuges is that the Service Manual outlines policy on developing comprehensive conservation plans and compatibility determinations, and provides policy on managing fish, wildlife, habitat, and public uses and controlling undesirable invasive species through integrated pest management procedures. Service policy was written within the sideboards established by applicable laws and executive orders and Department of the Interior policy, and provides greater detail than these overriding authorities.

Goals of the Refuge System, set by Service policy, further define the mission of the national network of refuges. It is the policy of the Service that they are to be used as a guide for developing individual refuge unit goals — all refuge goals must support the Refuge System goals. The goals of the Refuge System (602 FW 1.4.M) are:

1. To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;

2. To perpetuate the migratory bird resource;

3. To preserve a natural diversity and abundance of fauna and flora on refuge lands; and

4. To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment and to provide refuge visitors with high-quality, safe, wholesome, and enjoyable recreation experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

3.2.1.1.3 Establishing Authorities

Stillwater Wildlife Management Area (Stillwater WMA) was established through a 50-year agreement (1948 Tripartite Agreement) signed by the Service, Nevada State Board of Fish and Game Commissioners (now Nevada Division of Wildlife), and the Truckee-Carson Irrigation District on November 26, 1948. According to the agreement, Stillwater WMA is to be managed for the purposes of conserving wildlife and for public hunting. The agreement also specifies that the management of livestock grazing and muskrat production are to be managed commensurate with wildlife conservation and management. Althought the agreement expired in November 1998, the the Service continues to cooparatively manage the Stillwater WMA with the Bureau of Reclamation under most provisions of the 1948 agreement. Under the action alternatives in this Draft EIS, the extension of the Tripartite Agreement would not be renewed again, which would result in the termination of Stillwater Wildlife Management Area. Administration of lands not included within a new boundary of Stillwater NWR would revert back to the Bureau of Reclamation and its contractor (Truckee-Carson Irrigation District) or public land status. Stillwater NWR was originally established, within the Stillwater WMA, on October 21, 1949 for the purpose of providing a sanctuary for game birds and game mammals. This was done as outlined in the 1948 Tripartite Agreement.

Public Law 101-618, which expanded the size of Stillwater NWR and set it apart from the Stillwater WMA to the west, requires that Stillwater NWR, be managed for the purposes of: (1) maintaining and restoring natural biological diversity within the refuge; (2) providing for the conservation and management of fish and wildlife and their habitats within the refuge; (3) fulfilling international treaty obligations of the United States with respect to fish and wildlife; and (4) providing opportunities for scientific research, environmental education, and fish and wildlife oriented recreation. However, Public Law 101-618 also directed that any activity being permitted on the refuge under the 1948 Tripartite Agreement continue until the expiration of the Tripartite Agreement, the terms of which have been extended (USBOR 2000). Until the Record of Decision is signed for this Draft EIS, managing the refuge toward the establishing purposes of Stillwater NWR will not be fully undertaken. The potential effects on wildlife, habitat, public uses, and socio-economics that result from the change in management direction and administration instituted by Public Law 101-618 and the National Wildlife Refuge System Administration Act, as amended, are evaluated in Chapter 4 of this Draft EIS.

Fallon NWR, which is at the north end of Stillwater WMA (part of the refuge is within the WMA), was established in 1931 by Executive Order 5606 as a "...refuge and breeding ground for birds and wild animals..." The Executive Order expressly delineated the meaning of refuge as being a sanctuary.

Anaho Island NWR was established in 1913 by Executive Order 1819 as a "...preserve and breeding ground for native birds." Public Law 101-618 (§210(b)(2)) more narrowly defined

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the purpose of Anaho Island NWR, stating that it was to be managed and administered "...for the benefit and protection of colonial-nesting species and other migratory birds." The public law also recognized that Anaho Island is part of the Pyramid Lake Indian Reservation, but that it is to be managed and administered by the Service. The terms of the Service's management and administration of the island were outlined in a March 1992 memorandum of understanding (MOU) between the Service and the Pyramid Lake Paiute Tribe.

3.2.1.1.4 Boundary-Revision Authorization

Public Law 101-618 authorized the reevaluation of the boundary of Stillwater NWR for possible revision. The law specifically authorized the Department of the Interior to submit recommendations to Congress concerning: (a) revisions of Stillwater NWR boundaries as may be appropriate to carry out the purposes of Stillwater NWR and subsection 206(a) of the law, which identifies the 25,000-acre target for Lahontan Valley wetland-habitat; (b) transfer of any other U.S. Bureau of Reclamation withdrawn public lands within existing wildlife use areas in the Lahontan Valley to the Service for addition to the Refuge System; and (c) identification of lands currently under the jurisdiction of the Service in the Lahontan Valley that no longer warrant continued status as units of the Refuge System.

3.2.1.2 International Treaties and Other Agreements and Designations

3.2.1.2.1 International Treaties

Fulfillment of international treaty obligations with respect to fish and wildlife is one of the purposes for which Stillwater NWR is to be managed. These international treaties call for the establishment of reserves, sanctuaries, preserves, and other protected areas for the protection, conservation, and management of migratory birds and their habitat, wetland-dependent birds and wetland-habitat, biological diversity, species threatened with extinction, other plants and animals otherwise of national significance, and natural areas and ecosystems.

Treaty Responsibilities that apply to Stillwater NWR (boundary-revision and comprehensive conservation plan):

- establishment of refuges, reserves, and other protected areas for conserving migratory birds, biological diversity, threatened or endangered species, wetland habitat, and natural ecosystems.
- protection and conservation of all native species of plants, animals, and microorganisms
- restoration and maintenance of natural habitats and ecosystems, including protection of natural features of the landscape
- prevention of exotic species' introductions, and control of introduced species
- abatement of pollution
- management of public uses in a way that is compatible with the purposes for which the area was established

A common theme running through the treaties, with respect to managing areas set aside for the protection of fish and wildlife, is the restoration and protection of natural habitats and ecosystems. International treaties stress protection from pollution and detrimental alteration of habitats, controlling undesirable invasive species that can threaten ecosystems, and restoring degraded ecosystems. Another common theme is the management of public uses in a way that sustains the resources being used.

Treaties addressing fish and wildlife conservation

Signed by U.S.	Treaty
1993	Convention on Biological Diversity
1985	Convention of Wetlands of International Importance especially as Waterfowl Habitat
1976	Convention between the United States of America and the Union of Soviet Socialist Republics Concerning the Conservation of Migratory Birds and Their Environment
1976	Convention on Protection of World Cultural and Natural Heritage
1972	Convention between the Government of the United States of America and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment
1941	Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (United States and 7other American Republics)
1936	Convention between the United States and the United Mexican States for the Protection of Migratory Birds and Game Animals
1916	Convention between the United States and Great Britain (for Canada) for the Protection of Migratory Birds

3.2.1.2.2 Western Hemispheric Shorebird Reserve Network

The Stillwater Hemispheric Reserve, comprising Stillwater NWR, Stillwater WMA, Carson Lake, and Fernley WMA, is one of 14 Hemispheric Sites of the Western Hemispheric Shorebird Reserve Network (WHSRN; Map 2.1). WHSRN, which is a voluntary collaboration of more than 80 governmental and private organizations, provides international recognition to critically important shorebird habitats. WHSRN recognizes that shorebirds do not know national and international boundaries and that shorebird conservation requires an international approach. Participation in the network is voluntary and does not bind participants to any obligation or treaty, but it does promote cooperative management and protection of the sites as part of an international network. Stillwater Hemispheric Reserve was dedicated on August 20, 1988. Its nomination, and acceptance, as a Hemispheric Site was based on the fact that the area supports up to half of the North American population of long-billed dowitchers and hundreds of thousands of various shorebird species during migration.

A National Shorebird Conservation Plan is being drafted to address objectives and strategies for shorebird population recovery, habitat management, and public outreach (Oring and Neel 1999). The plan is being drafted regionally and contains a section on the Intermountain West region. It is anticipated to be completed in 2000.

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3.2.1.2.3 North American Waterfowl Management Plan

The North American Waterfowl Management Plan, adopted in 1986, established a cooperative effort between the United States, Canada and Mexico to reverse declines in waterfowl populations and their habitat throughout North America.

The 1986 plan established continental breeding-population goals for all North American species of ducks and habitat objectives to achieve these goals. It also established winter-population goals for all species of geese. Breeding-population goals were based on 1970-1979 population levels of ducks. Habitat objectives, expressed in numbers of acres of wetland-habitat to be protected, restored, and enhanced, are based on the assumption that "Restoring waterfowl populations to the levels of the 1970s would require continental habitat characteristics [acreages] similar to those present during the 1970s." This generally parallels one of the building blocks used to derive the 25,000-acre target of the Lahontan Valley wetlands water-rights acquisition program; i.e., the amount of primary wetland-habitat acreage present in the Lahontan Valley from 1972 to 1975. The 1994 Update to the North American Waterfowl Management Plan documents the progress made toward achieving population goals and habitat objectives, and lists additional recommendations to achieve them.

3.2.1.2.3.1 Intermountain West Joint Venture

The Intermountain West Joint Venture is a partnership between government and private organizations formed to meet objectives of the North American Waterfowl Management Plan. The Lahontan Valley wetlands, of which Stillwater NWR is a major component, are a focus area of this joint venture. As a focus area of the Intermountain West Joint Venture, Stillwater NWR Complex contributes toward achieving the primary goal of the joint venture, which is to "provide for the long-term conservation of wetland-habitats and their associated wildlife" in the Intermountain West (Intermountain West Joint Venture 1995). Another major goal of the joint venture is to restore and maintain migratory bird populations at 1970 levels. Specific population objectives, for years of average climatic conditions, include: (1) providing habitat to accommodate a breeding population of at least 2.5 million ducks, emphasizing the ten most common species; (2) providing migrational and staging habitat to support a fall migration of at least 20 million ducks; (3) provide habitat to support a midwinter population of at least 2.5 million ducks; (4) provide adequate habitat to maintain a migrational population of 60,000 tundra swans and 700 trumpeter swans; (5) continue to cooperate in conducting midwinter surveys; (6) provide nesting, migrational, and wintering habitat to maintain a midwinter population of 90,000 Canada geese; (7) identify the status of key breeding and staging habitats for certain non-waterfowl waterbirds (e.g., white pelican nesting colonies, Wilson's phalarope staging areas); and (8) establish more specific population objectives for non-waterfowl species as populations are determined.

The Concept Plan for the Preservation of Wetland-habitat of the Intermountain West (USFWS 1995) identified wetland protection goals for the Intermountain West Joint Venture area. In Nevada, the goal was to provide for the permanent protection of 96,500 acres of additional wetland-habitat. In addition, several habitat protection strategies were identified. Those applicable to the Stillwater NWR Complex include: (1) secure adequate water supplies for existing and newly acquired wetlands; (2) improve management of habitat on public and private wetlands (e.g., develop wildlife management plans, promote water-use efficiency, manage wetlands as self-sustaining natural systems); (3) promote efforts to improve water quality (e.g., secure supplies of good-quality water to dilute contaminated sources); (4) maintain wetland wildlife diversity, giving endangered species and other species of concern priority in habitat management; and (5) support and encourage efforts to alleviate losses of wildlife from carp, toxins, and diseases, especially botulism. Potential exists for the Stillwater NWR Complex to contribute further toward these population and habitat objectives to the extent that needed actions are consistent with the purposes for which the refuges are to be managed.

3.2.1.2.4 Other International Bird Conservation Initiatives

Following the North American Waterfowl Management Plan, three other international bird conservation initiatives have been undertaken. All four initiatives are now being coordinated under the North American Bird Conservation Initiative, the aim of which is the conservation of all North American birds. The other initiatives are:

- Partners in Flight
- North American Colonial Waterbird Management Plan
- U.S. Shorebird Conservation Plan

3.2.1.2.4.1 Partners in Flight

Partners in Flight is a voluntary collaboration of governmental and private organizations in North, Central, and South America. Like the WHSRN and the North American Waterfowl Management Plan, Partners in Flight was formed in recognition of the need to address migratory bird conservation at an international level. The primary goal of Partners in Flight is to improve the monitoring, research, management and education programs involving native, nongame landbirds and their habitats. The national Partners in Flight conservation strategy provides the framework for preparing habitat-based bird conservation plans that set conservation priorities and specific objectives for bird populations and habitats for every state. A draft of the Nevada Partners in Flight Bird Conservation Plan was released for review in February 1999, and a final plan is expected in 2000.

3.2.1.2.4.2 North American Colonial Waterbird Plan

This plan is in the initial stages of development.

3.2.1.2.4.3 U.S. Shorebird Conservation Plan

The U.S. Shorebird Conservation Plan, presently in draft form, is a collaborative effort between researchers, land managers, and education specialists to advance effective conservation of North American shorebird species through cooperation with colleagues from Mexico and Canada (Manomet Center for Conservation 2000). The plan, which has three main components (habitat management, research and monitoring, and education and outreach), has three main objectives: (1) develop a standardized, scientifically-sound system for monitoring and studying shorebird populations, which will provide practical information to researchers and land managers for shorebird habitat conservation; (2) identify principles and practices upon which all levels of management plans (local, State, Federal) can effectively integrate shorebird conservation with multiple species strategies; and (3) design an integrated approach for increasing public education about shorebird and wetland conservation. The national plan is divided into several regions, and the one applicable to Stillwater NWR Complex is the Intermountain West Region (Oring and Neel 1999).

3.2.1.3 Existing Service Plans and Programs

3.2.1.3.1 U.S. Fish and Wildlife Service Strategic Plan, 1997-2002

Nationwide, the Service has committed to conserving an ecologically diverse network of lands and waters by conserving migratory bird populations, stabilizing or improving populations of threatened and endangered species, and by protecting, restoring, or enhancing 64.7 million acres of uplands, 28.4 million acres of wetlands, 15.5 million acres of deep water and riverine habitat, and 3,250 miles of riparian habitat by the year 2002 (USFWS 1997). Another strategic goal is to increase opportunities for participation in uses of fish and wildlife resources by 3 percent from 1996 levels, and to increase the public's understanding of the relationship between healthy fish and wildlife resources and sound management practices. The Service also seeks to enhance the diversity and technical capability of its workforce. The Stillwater NWR Complex currently contributes to all of these strategic goals, and any modification to the boundary of Stillwater NWR would affect the level of contribution to several goals and adjustments in management and administration could contribute to others.

3.2.1.3.2 Region One's Ecosystem Management Strategy

Goals of the Service's *Ecosystem Management Strategy* for Region One are to: (1) provide leadership to conserve ecological systems within Region One at all landscape levels for present and future generations; (2) restore, conserve, and protect the health of ecological systems; and (3) foster and perpetuate a land stewardship ethic in cooperation with other agencies, organizations, businesses, and the general public. Some of the pertinent objectives include (1) maintaining viable populations of native plants and animals well distributed throughout their geographic range; (2) maintaining genetic variability within and among populations of native species; (3) restoring and maintaining representative examples of the full spectrum of natural ecosystems, biological communities, and habitats; (4) restoring and maintaining soil productivity, water quality, and air quality; (5) restoring and maintaining the fundamental patterns and processes that operate within each system; (6) increasing scientific understanding of biological diversity and ecological processes; (7) increasing public awareness, understanding, and support for conserving biological diversity and ecosystem management; and (8) maximizing the extent to which production and maintenance of consumptive and nonconsumptive resources are carried out in an environmentally sensitive manner at levels that ensure a high probability that long-term human and economic well being can be maintained. Strategies include the establishment and management of reserves and other protected areas throughout Region One.

3.2.1.3.3 Interior Basin's Ecoregion Plan

Although the Interior Basin's Ecoregion plan has not been completed, it provides an unofficial view of the priorities identified during this ecoregion-wide Service planning effort. In the most recent draft (February 1995), the highest priority for the Interior Basin's Ecoregion was to protect and restore Lahontan Valley wetlands. Objective 3 was to prepare an EIS and comprehensive plan for Stillwater NWR and the Lahontan Valley wetlands. Objectives 1 and 2 were to complete the water-rights acquisition EIS and secure water rights for Lahontan Valley Wetlands.

Priority 2 of the draft plan was to protect and restore Pyramid Lake and Lower Truckee River, Nevada. Objective 1 was to secure adequate water to support a healthy Pyramid Lake ecosystem. Priority 8 was to protect and restore Great Basin streams and riparian systems in Nevada, Utah, Oregon, and Wyoming. Objective 2 of Priority ten (sensitive, rare, and candidate species) was to inventory and conserve sensitive sand dune ecosystems. Public education was identified as Priority 13.

3.2.1.3.4 1987 Management Plan for Stillwater Wildlife Management Area

The *1987 Management Plan for Stillwater Wildlife Management Area*, including (as per the Tripartite Agreement) Stillwater NWR and Fallon NWR, was consulted during the development of this Draft EIS. This forms the basis of, and is described in, Alternative A, the No Action Alternative.

3.2.1.3.5 Water-Rights Acquisition Program

A water-rights acquisition program for Stillwater NWR and other designated Lahontan Valley wetland areas was initiated in 1990. The acquisition program is authorized and directed by Public Law 101-618. Specifically, subsection 206(a) of Public Law 101-618 directs the Secretary of the Interior to acquire enough water and water rights, in conjunction with the State of Nevada and other parties, to sustain a long-term average of 25,000 acres of primary wetland-habitat in the Lahontan Valley. The *Final Environmental Impact Statement* *for Water Rights Acquisition for Lahontan Valley Wetlands* (WRAP EIS) describes a water-rights acquisition program implemented by the Service in November 1996 when the record of decision was signed for the WRAP EIS. The WRAP EIS estimated that 125,000 acre-feet of water would be needed to sustain 25,000 acres of wetland-habitat.

Key elements of the selected alternative include the continued use of irrigation drainwater and periodic excess water released from Lahontan Reservoir, acquisition of 75,000 acre-feet of water rights in the Carson Division of the Newlands Irrigation Project, acquisition of water rights from the middle Carson River, leased water rights in the Carson Division, water conserved at the Naval Air Station-Fallon, and groundwater pumping. Together, these sources of water are anticipated to provide a long-term average of 125,000 acre-feet of water for the wetlands. As of March 1999, approximately 28,080 acre-feet of water rights in the Carson Division had been acquired, including 19,650 acre-feet by the Service for Stillwater Refuge, 8,150 acre-feet by the State of Nevada and Nevada Waterfowl Association for Carson Lake, and 280 acre-feet for the Bureau of Indian Affairs for the Fallon Paiute-Shoshone Indian Reservation wetlands.

Of the 25,000 acre target, an average of 14,000 acres of wetland-habitat would be sustained over the long term on Stillwater NWR, which is estimated to take about 70,000 acre-feet of the 125,000 acre-feet for the Lahontan Valley wetlands. Another 10,200 acres would be sustained on Carson Lake Wildlife Management Area, and the remaining 800 acres would be sustained on the Fallon Paiute-Shoshone Indian Reservation.

The WRAP EIS and ROD acknowledged that a long-term average of 125,000 acre-feet per year demand was an estimate, and could be revised. In the WRAP EIS, the Service pointed out that the amount of water needed to manage wetlands on Stillwater NWR to achieve refuge purposes would be reevaluated, but the Service agreed not to exceed a long-term average of 125,000 acre-feet per year, unless monitoring at the end of the acquisition program reveals that additional water is needed to sustain a long-term average of 25,000 acres of primary wetland-habitat. Thus, for the purposes of this Draft EIS, it is assumed that the maximum amount of water available to the primary wetland areas in the Lahontan Valley is a long-term average of 125,000 acre-feet per year. It is also assumed, for this Draft EIS, that Stillwater NWR's portion would be a maximum of 70,000 acre-feet per year.

3.2.1.4 Components of Refuge Purposes and Boundary-Revision Criteria

This section provides a detailed listing of the individual components of natural biodiversity, wildlife-dependent recreation, and other key parts of refuge purposes for use in developing management objectives and strategies, and formulating boundary alternatives for Stillwater NWR.

3.2.1.4.1 Components of Refuge Purposes

The many components of refuge purposes were considered during the formulation of management objectives and strategies. The following list is one way to categorize the

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components of refuge purposes. The list is organized by refuge purposes and identifies only those components applicable to the management of the refuges, not those that are addressed at a higher level (e.g., waterfowl hunting regulations established at the flyway level).

Components of Refuge Purposes

STILLWATER NWR

Natural Biological Diversity
- Richness of native species (identity and number of native species)
- Relative abundance of each native species
- Richness of native biotic communities and guilds
- Relative abundance and size of native communities and guilds
- Natural structural complexity of plant communities (e.g., patterns, vertical structure)
- Richness of native biotic processes (e.g., succession, herbivory, predation, migration)
- Extent, level, and rates of native biotic processes

Fish, Wildlife, and their Habitat
- All species, taxonomic groups, and guilds of animals (vertebrates and invertebrates)
- High-quality and secure habitat for wildlife, especially:
  - habitat for breeding, feeding, resting, and wintering, including escape and thermal cover
  - habitat for threatened and endangered species
- Vegetative elements of habitat
- Physical elements of habitat (e.g., water quantity, geologic features)

International Treaty Obligations
- All species of native animals and plants, especially:
  - migratory birds (all native bird species except upland gamebirds)
  - threatened and endangered species
  - other species of national or global significance
  - all other native species of animals and plants
- Habitats for above species; emphasis on natural habitats and ecosystems
- Prevalence and spread of noxious weeds
- Sanctuary areas for hunted species
- Natural features of the landscape

Scientific Research, Environmental Education, and Wildlife-oriented Recreation
- Scientific Research
- Environmental Education
- Wildlife-oriented public uses, such as:
  - Environmental Interpretation
  - Hunting
  - Fishing
  - Wildlife Observation
  - Wildlife Photography

FALLON NWR
- Sanctuary for waterfowl and other wildlife, including:
  - habitat for breeding, feeding, resting, and wintering, including escape and thermal cover
- Secure, high-quality breeding habitat for waterfowl and other migratory birds, especially:
  - nesting and brood-rearing habitat
- Secure, high-quality breeding habitat for other wildlife

ANAHO ISLAND NWR
- Secure breeding habitat for colonial nesting birds
- Secure breeding habitat for other migratory birds

3.2.1.4.2 Boundary-Revision Criteria

For the boundary assessment effort, refuge purposes were divided in a somewhat different way. Subsection 206(b)(5) of Public Law 101-618 specifies two sets of criteria upon which to base revisions to Stillwater NWR's boundary: (1) extent to which a boundary revision would facilitate the Service's ability to carry out the purposes of Stillwater NWR, and (2) the extent to which a boundary revision would facilitate efforts to carry out provisions of subsection 206(a) of the law. These criteria and other considerations are identified below.

3.2.1.4.2.1 Refuge Purposes

Areas being studied for potential inclusion into Stillwater NWR were evaluated against several specific measures under each of the refuge purposes listed in subsection 206(b)(2) of Public Law 101-618. These measures are based on the Refuge System Administration Act, Service policy, international treaties, and principles of natural resource management. Refuge purpose are listed below, followed by specific boundary-revision criteria for each.

Boundary-Revision Criteria: Stillwater NWR Purposes

Purpose: Restore and maintain natural biological diversity within Stillwater NWR.

1. Representativeness. Does the area contain native species or biotic communities not already effectively represented within the existing boundary of Stillwater NWR?
2. Sensitive and Rare Species. Does the area contain sensitive or rare species, especially those listed as endangered or threatened, or candidates for listing?
3. Naturalness. Is the area in a relatively natural state and is it in relatively healthy ecological condition, or does it have potential to be restored as such?
4. Refuge Size and Shape. Would addition of the area contribute to making Stillwater NWR of a size and shape that would enhance the ability to conserve natural biological diversity over the long term?

Purpose: Conserve and manage fish, wildlife, and their habitat within Stillwater NWR.

1. Habitat for Key Species. Does the area provide important breeding, wintering, or migration habitat for key species or groups of wildlife, especially those dependent on marsh and riparian habitat?
2. Endangered Species Protection. Does the area contain habitat for species threatened with extinction?
3. Protection from Harvesting and Collection. Does the area or a portion of the area provide high-quality sanctuary for animal and plant species that are harvested or commercially collected (e.g., reptiles)?

Purpose: Fulfill international treaty obligations with respect to fish and wildlife.

1. Migratory Bird Habitat. Does the area contain habitat important for migratory birds such as waterfowl and neotropical migratory birds?
2. Sanctuary Potential. Could the area or portions of the area provide additional sanctuary (non-hunted area) for migratory birds?
3. Biodiversity Conservation. Does the area contain or have the potential to contain components of biological diversity not effectively represented in the existing boundary of Stillwater NWR?
4. Natural Area Protection. Does the area contain a geographic feature of regional/national significance?

Purpose: Provide opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation.

1. Scientific Research. To what extent would the area enhance or increase opportunities on Stillwater NWR for scientific research, especially research related to achieving refuge purposes?
2. Wildlife-Dependent Recreation. To what extent would the area enhance opportunities on Stillwater NWR for wildlife-dependent public use (such as hunting, fishing, wildlife observation and photography, and environmental education and interpretation), especially those that are oriented towards families?

3.2.1.4.2.2 Subsection 206(a) of Public Law 101-618

Subsection 206(a) authorizes and directs the Service to acquire, in conjunction with the State of Nevada and other parties that may provide water, sufficient water and water rights to sustain a long-term average of 25,000 acres of primary wetland habitat in four designated areas in the Lahontan Valley: Stillwater NWR, Stillwater WMA, Carson Lake, and the Fallon Paiute-Shoshone Indian Reservation. This subsection lays the foundation for restoring and providing long-term protection to the Great Basin wetland ecosystem in the Lahontan Valley. A criterion for evaluating lands for potential inclusion into Stillwater NWR, therefore, was the extent to which the area would contribute toward achieving the 25,000-acre wetland habitat objective for Lahontan Valley wetlands.

3.2.1.4.2.3 Other Considerations

Although the boundary-revision criteria identified above were the main factors guiding the development of the alternative boundaries, they were weighed against other factors such as administrative complexity and costs, law enforcement, operation and maintenance of facilities, and other issues identified during scoping.

3.2.2 Other Factors Considered During Alternative Development

3.2.2.1 Federal Laws and Memorandums of Understanding

Below are the some of the memorandums of understanding that were reviewed during the development of alternatives.

3.2.2.1.1 1948 Tripartite Agreement and Amendments

The 1948 Triparite Agreement is an agreement between the Service, Nevada State Board of Fish and Game Commissioners (now NDOW), and the Truckee-Carson Irrigation District that outlines the establishment of Stillwater WMA and Stillwater NWR and broad direction for managing the area. Althought the agreement expired in November 1998, the the Service continues to cooparatively manage the Stillwater WMA with the Bureau of Reclamation under most provisions of the 1948 agreement (USBOR 2000).

According to the 1948 Tripartite Agreement, Stillwater WMA is to be managed for the purposes of conserving wildlife and for public hunting. The agreement also specifies that the management of livestock grazing and muskrat production are to be managed commensurate with wildlife conservation and management. The agreement covers a number of other issues, including use of the area for discharging "waste water" not used by the irrigation project, the construction and operation of canals and other water control facilities, and staffing the area.

3.2.2.1.2 Management and Administration of Anaho Island NWR

According to Public Law 101-618 (subsection 210(b)(2)), Anaho Island NWR, which is located within and is part of the Pyramid Lake Indian Reservation, is to be managed and administered under the primary jurisdiction of the Service as an integral component of the Refuge System. The public law also authorized the Service to enter into cooperative agreements with the Pyramid Lake Paiute Tribe with respect to the management of Anaho Island. Such an agreement was signed by both parties in 1992. The MOU outlines general guidance for managing the island and for continued cooperation between the Service and the Tribe.

3.2.2.1.3 Naval Air Station-Fallon Overflights

A MOU was signed in 1987 by the Service, Bureau of Land Management, Department of the Navy, and the State of Nevada for the Naval Air Station-Fallon's special air space. Stillwater WMA, which included the area now within Stillwater NWR, Stillwater WMA, and Fallon NWR, was recognized as overflight sensitive. As part of the agreement, Naval Air Station flights will not, under any circumstances, fly over Stillwater WMA lower than 3,000 feet above the ground.

3.2.2.1.4 Cultural Resource Management

The management of a national wildlife refuge like Stillwater NWR invokes the cultural resource legislation listed in Appendix A, on a continuing, almost daily, basis. Almost all activities that disturb the ground at Stillwater NWR invoke the National Historic Preservation Act (NHPA). The Archaeological Resources Protection Act, the Native American Graves Protection and Repatriation Act, and Section 110 of the NHPA call for an active cultural resource program.

It is the policy of the Service to take no action that would diminish the ability of American Indians, specifically the Fallon Paiute-Shoshone Tribe, to carry on their traditional culture. Indeed, many laws, including the National Historic Preservation Act, the Native Americans Graves Protection and Repatriation Act, the Sacred Sites Executive Order imply that the Service would take steps to ensure the cultural legacy of the Fallon Tribe. If the trust responsibility of the Service involves cultural resources, the Service would take steps to manage such resources so that they are preserved and enhanced in consultation with the Tribe.

Much of the cultural resource management at Stillwater NWR has been conducted in response to the land, habitat, wildlife, and public-use management of the refuge. However, given the richness of cultural resources on the refuge, the Service has implemented a few agreements, in compliance with Federal legislation, that tailor cultural resource management to the specific needs of the refuge. These agreements include:

- Stillwater Marsh National Register Archaeological District (1974) a 42,000-acre area roughly coinciding with the present Stillwater NWR.

- MOU concerning human remains between the U.S. Fish and Wildlife Service, Nevada State Historic Preservation Office, and the Fallon Paiute-Shoshone Tribe, 1988.

- Programmatic Agreement for cultural resource management at Stillwater Wildlife Management Area between the U.S. Fish and Wildlife Service, Bureau of Reclamation, Nevada State Historic Preservation Office, and the Advisory Council on Historic Preservation, 1988.

- Programmatic Agreement between the U.S. Fish and Wildlife Service Region One, Nevada State Historic Preservation Office, and the Advisory Council on Historic Preservation regarding the Administration of Routine Undertakings by the U. S, Fish and Wildlife Service, 1997.

The refuge would carry out the terms of these agreements and the basic compliance responsibilities of Federal cultural resource legislation regardless of the alternative chosen and the comprehensive conservation plan that is implemented.

3.2.2.1.5 Wilderness Study

In December 1974, a bill was presented to Congress (House Document No. 93-403, Part 29) proposing to add the Anaho Island National Wildlife Refuge to the National Wilderness Preservation System. This bill was neither enacted nor was it dismissed. Anaho Island retains its essential wilderness character as a roadless island, and in accordance with Service policy, is managed as if it has been designated. Finalization of the wilderness designation proposal would require extensive updating of the documents to accurately reflect current conditions. Considerable changes in the environmental and political arena have occurred since 1974 that were not anticipated or considered in the original wilderness review and environmental documents accompanying the proposal. In 1974, Anaho Island was not considered to be part of the Pyramid Lake Paiute Indian Reservation. Title II of the Truckee-Carson-Pyramid Lake Water Settlement Act of 1990 (Public Law 101-618) formally recognized Anaho Island as part of the Pyramid Lake Indian Reservation, although management and administration of the island remains under the primary jurisdiction of the Service, as a part of the Refuge System. The Pyramid Lake Paiute Tribal Council's Resolution 19-90 acknowledged the continuing management jurisdiction of the Service and, in 1992, the Service entered into a Cooperative Agreement with the Tribe regarding the management of Anaho Island NWR. The consent and cooperation of the Pyramid Lake Paiute Tribe would be necessary to re-initiate a wilderness review and update the proposal to designate Anaho Island as wilderness.

Upon the establishment of a new approved refuge boundary for Stillwater NWR, or a determination that the existing boundaries of Stillwater NWR and Fallon NWR will remain

3.3.1.1 Features and Assumptions Common to All Alternatives

All alternatives contain several common features and assumptions, which would be part of the comprehensive conservation plan regardless of alternative selected for implementation. Such features and assumptions are presented below to reduce redundancy of the individual alternative descriptions.

Water-Rights Acquisition Program

- A long-term average of 14,000 acres of primary wetland-habitat would be sustained on in effect, a wilderness review would be conducted (see Section 3.3.1.2). The Wilderness Act of 1964 (16 U.S.C. 1131-1136, 78 Stat. 890) – Public Law 88-577 (Wilderness Act), was enacted "*To establish a National Wilderness Preservation System for the permanent good of the whole people, and for other purposes*." In the Wilderness Act, wilderness is defined as an area where "man himself is a visitor". Wilderness areas are absent of "permanent improvements or human habitation" and (1) affected primarily by nature; (2) possess opportunities for solitude; (3) are generally over 5,000 acres; (4) are managed to allow natural processes to operate; (5) may contain scientific, educational, scenic or historical features; and (6) formally designated by Congress.

Wilderness conservation was listed as the first goal under the Action Plan for the National Wildlife Refuge System in the Service Director's Priorities (Fiscal year 1999-2000), a document which clearly articulated the importance of this designation: "Wilderness, due to its very nature, is extremely important to the conservation of biodiversity within the System. Wilderness is a reservoir of biological diversity and natural ecological and evolutionary processes. Wilderness is also a way of perceiving and valuing; it is as much about a relationship with the land as the condition of it. Wilderness is a symbolic landscape, encompassing values and benefits that extend beyond its boundaries."

3.2.2.1.6 Accessibility for Disabled Persons

The Service is required to comply with section 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990. Section 504 of the Rehabilitation Act, as amended, prohibits discrimination on the basis of disabilities in programs and activities that receive Federal financial assistance or are conducted by Federal agencies. The Americans with Disabilities Act of 1990 provides standards for addressing discrimination against individuals with disabilities in employment, transportation, telecommunications, public accommodations, and services operated by private entities.

3.2.2.2 Issues

Issues identified during the internal and public scoping process were considered during the development of alternatives. Six key issues were identified with respect to revising the boundary of Stillwater NWR and the development and implementation of a comprehensive conservation plan for the Stillwater NWR Complex:

1. Potential effects on wildlife of Stillwater NWR, Stillwater WMA, Fallon NWR, and Anaho Island NWR.

2. Potential effects on wildlife habitat and ecosystem functioning on Stillwater NWR, Stillwater WMA, Fallon NWR, and Anaho Island NWR.

3. Potential effects on public use of Stillwater NWR, Stillwater WMA and Fallon NWR.

4. Potential effects on the socioeconomics of Churchill County.
5. Potential effects on cultural resources of Stillwater NWR, Stillwater WMA and Fallon NWR.
6. Potential effects on Naval Air Station-Fallon operations.

These issues are discussed in more detail in Chapter 1.

3.2.2.3 Significant Problems Affecting Fish, Wildlife, and Plants

As required by the Refuge System Administration Act, as amended, and other management authorities, comprehensive conservation plans must identify actions necessary to correct, or mitigate, significant problems that adversely affect populations and habitats of fish, wildlife, and plants within the planning unit. Because refuges are managed first and foremost for the conservation of fish, wildlife, plants, and their habitat, the alternative-development process focused on the formulation of objectives and strategies to resolve issues in a way that would most effectively accomplish this fundamental mission, according to specific direction provided in refuge purposes. Especially important in developing objectives and strategies to achieve Stillwater NWR purposes was the need to address significant problems that are negatively affecting, or have the potential to negatively affect, the natural diversity of fish, wildlife, and plants, such as:

- Insufficient water volume and altered timing of inflows, and flow restrictions;
- Prevalence and spread of nonnative plant and animal species, including cattle; and
- Altered chemistry of wetland inflows.

Two key components of the natural biodiversity of the Stillwater area, which are affected by the same core problems, especially the first two, are waterfowl and shorebirds. Similarly, most of the species identified as threatened or species of special concern are likewise affected by inadequate water supplies. To effectively provide high-quality habitat for waterfowl, shorebirds, and other wetland birds, these problems must be addressed.

3.2.2.4 Other Plans that were Considered

3.2.2.4.1 Churchill County Master Plan

The 1995 update of the Churchill County 1990 Master Plan was reviewed during the development of alternatives. Lands within Stillwater NWR, Stillwater WMA, and Fallon NWR were identified in the 1995 update of the Churchill County 1990 Master Plan were designated as public in the Land Use and Transportation Plan map (Map #24 in the Master

Plan). This land-use designation indicates that the lands should remain in public use for the 20-year planning horizon.

The Policy Plan for Public Lands, included in the updated Master Plan, outlines Churchill County policies on the management of Federal lands. Because the plan was developed in response to the Federal Land Policy and Management Act, most policies pertain to Bureau of Land Management lands. Policies that apply to the planning unit include those on land disposals, retention of public lands in public ownership, access, recreation, geothermal areas, wilderness, agriculture, and wildlife. Many, but not all, of these policies are consistent with the Refuge System Administration Act and other laws governing the management of national wildlife refuges. The policies were interpreted in the context of the plan's specific policy with respect to the planning unit: Stillwater NWR should be managed primarily for wildlife.

3.2.2.4.2 Lahontan Valley Trails System

The Churchill County Planning Department is currently developing a multipurpose trail system to connect the existing parks and schools within the city and provide alternative recreational opportunities to the residents of the county through the provision of a trail system for bicyclists, joggers, hikers, and equestrians. The goals of the project are (1) to provide additional recreational opportunities that residents of Churchill County identified as a priority (Churchill County Master Plan 1990, 1997); (2) to develop a multipurpose trail system for bicyclists, joggers, hikers, and equestrians between Lahontan Reservoir and Stillwater NWR by the year 2007; and (3) to provide an alternative transportation system in and around the City of Fallon. Several sections have been developed and signed to date.

3.2.2.5 Funding Considerations

Because all alternatives must be equally analyzed for implementation, funding considerations must be addressed. The cost to implement each alternative is presented based on typical staff and projects expected for each alternative. Projections are based on normal and predicted budgets. The management activities and projects outlined would be implemented as funds become available. The level of funding required to implement the plan is considered "reasonable" over the next 15 years. However, there may be periods when budgets are lower and it is difficult to obtain funding for even high priority projects. Funding constraints may influence the priority of implementation.

3.2.2.6 Management Philosophy

The alternatives that were developed and presented in this Draft EIS outline different ways to address refuge purposes and the Refuge System mission. Each alternative reflects a different management philosophy, or school of thought, with respect to managing the Stillwater NWR Complex toward a desired end. In some cases, the desired end conditions are different. In other cases, the means to reach the desired conditions are different.

One way that alternatives differ is the level at which wildlife and habitat objectives were developed. Objectives can be developed at several points along a continuum (Figure 3.1) from objectives pertaining to the physical environment and ecological processes to objectives pertaining to the diversity (e.g., richness, abundance, distribution) of species of plants, animals, and microorganisms. Figure 3.1 is a simple illustration of some of the main hydrologic factors that affect biological resources and the different levels at which objectives can be developed to ultimately address biological goals (e.g., natural biological diversity, high waterfowl numbers).

Anchored in different sets of assumptions, each approach represents a different management philosophy. For example, setting objectives based on natural environmental conditions and

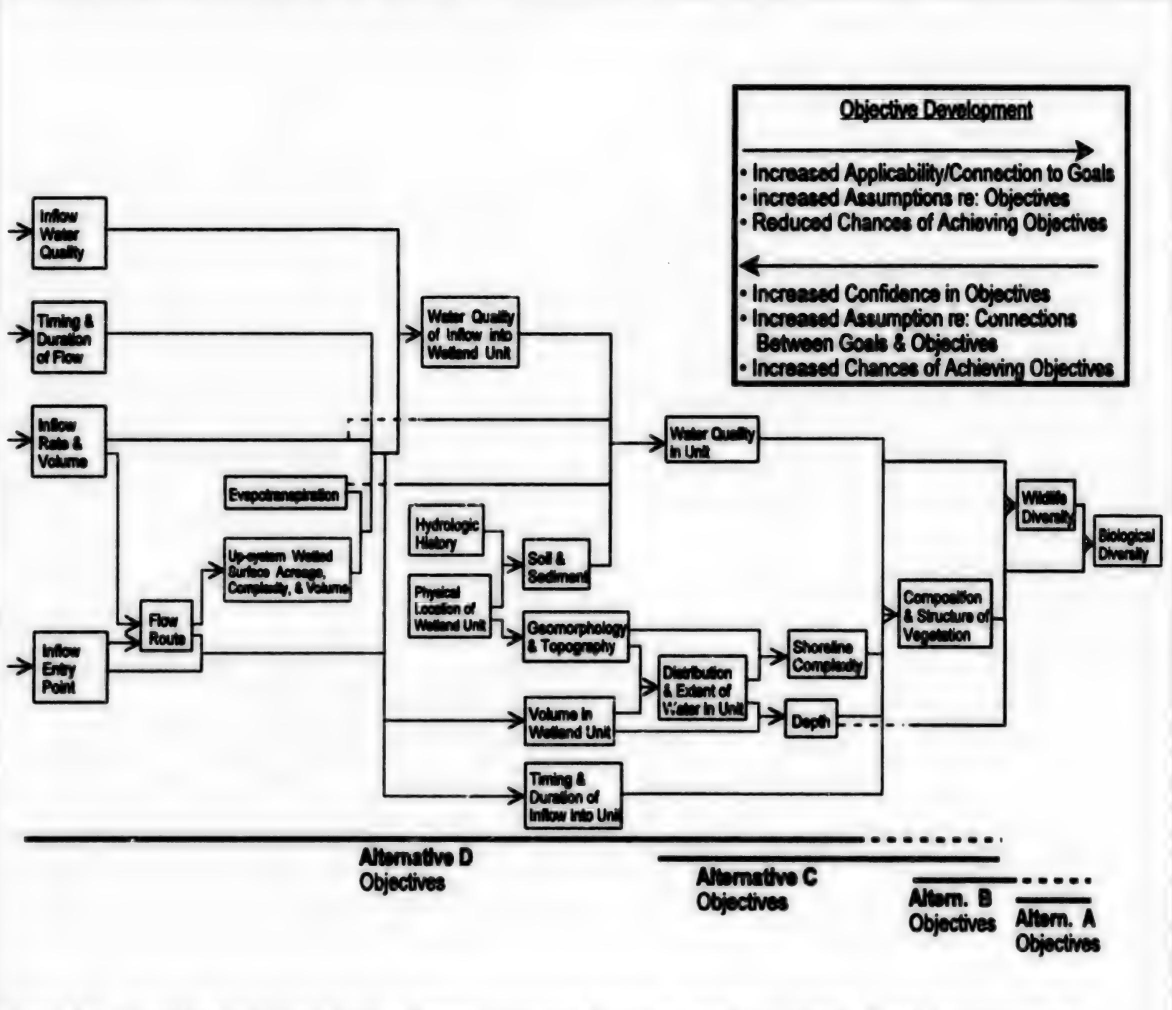
Objective Development
• Increased Applicability/Connection to Goals
• Increased Assumptions re: Objectives
• Reduced Chances of Achieving Objectives
• Increased Confidence in Objectives
• Increased Assumption re: Connections Between Goals & Objectives
• Increased Chances of Achieving Objectives
Inflow Water Quality
Timing & Duration of Flow
Inflow Rate & Volume
Evapotranspiration
Up-system Wetted Surface Acreage, Complexity, & Volume
Flow Route
Inflow Entry Point
Water Quality of Inflow into Wetland Unit
Hydrologic History
Physical Location of Wetland Unit
Soil & Sediment
Geomorphology & Topography
Volume in Wetland Unit
Timing & Duration of Inflow into Unit
Distribution & Extent of Water in Unit
Shoreline Complexity
Depth
Water Quality in Unit
Composition & Structure of Vegetation
Wildlife Diversity
Biological Diversity
Alternative D Objectives
Alternative C Objectives
Altern. B Objectives
Altern. A Objectives

Figure 3.1. On-refuge hydrologic factors affecting biological diversity on Stillwater NWR, and their relationship to objective development under each alternative (the lines at the bottom of the figure delineate the factors addressed in objectives under each alternative). The four factors listed at the far left of the figure, which are the major factors affecting biological diversity in refuge wetlands, are influenced in large part by off-refuge factors such as up-river diversions for agriculture and municipal use, Lahontan Reservoir operations, Sierra snowpack and runoff, and, recently, the Service's water-rights acquisition program. The insert in the top right corner illustrates several factors considered during objective development; e.g., developing population or diversity objectives for wildlife (far right in flow diagram) has a direct link to wildlife-related goals, but there is a limited understanding of natural population levels and given the many off-refuge factors affecting wildlife populations, achieving population objectives in any year is questionable.

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operation of ecological processes is a logical choice because our understanding of these conditions and processes is relatively high. However, establishing objectives at this level assumes that desired habitat conditions would automatically result from achieving these objectives and, what is more important, that the desired diversity of animals and plants would result from these habitat conditions. Given markedly changed conditions — including significantly reduced water supply, highly altered water chemistry, and the introduction of numerous nonnative species — replicating natural environmental conditions and ecological processes would not be a simple feat, nor would it guarantee the desired levels of natural biological diversity. If objectives are met, it does not necessarily mean that the goals will be achieved.

At the other end of the spectrum, establishing objectives that specify the natural richness, abundance, distribution, and structural complexity of animal and plant species and communities, and the richness, distribution, rates, and levels of biotic processes (i.e., natural biological diversity) assumes that these parameters can be estimated relatively accurately. If objectives could be established at this level, it would provide managers with a much more discernable target and would provide more management flexibility in terms of strategies to achieve objectives. However, as opposed to estimating natural environmental conditions, the natural diversity within and among biotic communities can only be roughly approximated and would require many assumptions. Even estimating the natural diversity of representative species and communities could only be done roughly and with many assumptions. Thus, achievement of objectives would only result in goal attainment if objectives correctly reflect natural biological diversity, and this would be difficult to determine. Another consideration is that refuge managers have much less control over populations of wildlife than they do over their habitat (e.g., water, topography, vegetation).

There are several places between these two end points at which objectives can be developed Also, one particular set of objectives can address parameters at several different points along the continuum, depending on the conditions ultimately desired, level of information available, comfort level with respect to assumptions, among other factors.

3.3 OVERVIEW OF ALTERNATIVES

This section presents an overview of the alternatives considered in detail, including features and assumptions that are common to various alternatives, and describes several other alternatives that were considered but not studied in detail.

3.3.1 Alternatives Considered in Detail

The four alternatives that are considered in detail in this Draft EIS are summarized in the Summary document and in Table 3.1 (next several pages), and are described in more detail in section 3.4.

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Table 3.1. Summary of the alternatives considered in detail.

	Alternative A (No Action)	Alternative B	Alternative C (Preferred Alternative)	Alternative D
Boundary (acres of Federal land) Stillwater NWR	79,570 ac.	79,570 ac.	137,504 ac.	167,806 ac.
Stillwater WMA	65,603 ac.	0 ac.	0 ac.	0 ac.
Fallon NWR	17,848 ac.	17,848 ac.	0 ac.	0 ac.
Total	163,021 ac.	97,418 ac.	137,504 ac.	167,806 ac.
Ave. Wetland Habitat Acreage	14,000 ac.	14,000 ac.	14,000 ac.	14,000 ac.
Ave. Annual Water Supply	70,000 AF	70,000 AF	70,000 AF	70,000 AF
WILDLIFE/HABITAT MGT.				
Biological Focus	Key Species	Key Species	Natural Biodiversity	Natural Biodiversity
Focus of Habitat Mgt.	Needs of Key Species in the breeding season (primary) and fall/winter (secondary)	Needs of Key Species in fall/winter (primary) and breeding season (secondary)	Approximation of Natural Habitat Conditions (primary) and needs of key species (secondary)	Approximation of Natural Ecological Processes
Hydrology				
Hydrology - Pattern of Inflow	Agricultural (imposed by Wetlands Water Rights EIS)	Fall Emphasis (and assumes carryover to spring)	Modified Natural (modified to minimize nest flooding, and to ensure that wetland-habitat is provided in the fall/winter)	Natural
- Inflow Rate Operational	up to 175 cfs	up to 150 cfs	up to 450 cfs	up to 350 cfs
Maximum	up to 450 cfs (existing capacity)	up to 450 cfs	800-1,000 cfs	≥1,000 cfs
- Diking	Existing	Additional diking	Evaluate existing for possible targeted additions/reductions	Reductions to simulate a more natural flow & geom.
- Riparian Restoration	None	Limited - Stillwater Slough	Moderate to high level	Moderate to high
- Contaminants	Minimize	Minimize	Minimize	Minimize
Average Wetland Habitat Acres in Stillwater Marsh, Nonspill Year - Spring	12,000-13,100	11,100-13,500	15,800-18,400	13,000-26,300
- Fall/Winter	12,300-13,100	12,400-14,600	10,000-11,500	5,200-7,000

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	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**
Prescribed Burning	Very Limited (<100 wetland acres/5 years)	Moderate (for key spp.;100-400 acres/year)	Limited (to provide for needs of key species;75-100 acres/ year)	No prescribed burning
Livestock Grazing	5,500-11,000 AUMs/yr - throughout Stillwater WMA - throughout Fallon NWR - Stillwater NWR sanctuary - no habitat objectives	500-1,000 AUMs/yr - agricultural areas for geese - reduce emergent vegetation	0-500 AUMs/yr - agricultural areas for geese - very limited to reduce emergent vegetation - goats & sheep in IPM - no cattle in riparian & uplands	0 AUMs/yr
Revegetation	Continued on former farmland, & limited in riparian	Former farmland, & limited in riparian	Former farmland, & increased effort in riparian	Former farmland & riparian, w/ emphasis on natural revegetation
Farming for Waterfowl	None	300-400 acres (non-Service water rights needed)	200-300 acres (non-Service water rights needed)	None
Nonnative Vegetation Control	Limited	Moderate, cont'd use of mechanical & herbicides	IPM – mechanical, biological (goats, sheep, insects), water management, mechanical, fire, & herbicides	IPM – no herbicides, & limited mechanical
Nuisance Animal Management				
- Raven & Coyote Control	None to limited, to increase waterfowl production	Moderate, to increase waterfowl production	Limited (e.g., if demonstrated to limit natural production rates)	None
- Muskrat Control	Not currently managed as a control measure (muskrat trapping provides recreation and commercial opportunities)	Similar to Alternative A	Minimize damage to water-control facilities and roads (and rarely to reduce grazing of emergent vegetation)	None
- Carp Control	None to limited	Moderate, use of water management and chemicals	Limited to mod., use of water control and limited chemicals	None
- Mosquito Control	None	None, but contingency plan would be developed incase of disease outbreak	None, but contingency plan would be developed incase of disease outbreak	None

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	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**
Human Disturbance				
- Apportionment of Wetland-habitat	1st 500 acres to sanctuary then the amount of sanctuary would be maintained as follows: Total Acres / Amount in Sanctuary <4,000 — 55-75% >4,000-11,000 — 35-40% >11,000 — ≤30%	1st 4,000 acres to sanctuary then all remaining wetland-habitat could be produced in the hunt area (except that an additional 500-1,000 acres of wetland habitat could be produced in the sanctuary)	1st 4,000 acres to sanctuary *Option 1:* next 3,000 acres to hunt area each additional 2,000 acres to: 1) general public use (500 ac.) 2) sanctuary (500 ac.) 3) hunt area (1,000 ac.) *Option 2:* each additional 5,500 acres to: 1) general hunt area (2,500 ac.) 2) primitive hunt area (2,500 ac.) 3) sanctuary (500 ac.)	1st 4,000 acres to sanctuary each additional 3,500 acres to: 1) gen. public use (1,000 ac.) 2) hunt area (2,000 ac.) 3) sanctuary (500 ac.)
- Wetland Units in Sanctuary	All units south of Division Road	All units south of Division Road	*Option 1:* Stillwater Point Reservoir, Upper Foxtail Lake, West Marsh, & Lead Lake *Option 2:* All units south of Division Road, except Cattail Lake	All units south of Division Road
- Wetland Units in Restricted-Access Areas	None	None	*Option 1:* None *Option 2:* West Marsh & Swan Lk.	None
- Boating	Few restrictions (airboats & outboards permitted year-round)	No boating April 1 to August 1. No Airboats. Boats with outboards motors (up to 15 hp) permitted during hunting season (but regulate more closely)	No boating March 1 to August 1, except non-motorized in Goose Lake. Boat operation during remainder of the year would be restricted to 15 hp motors, and a 5 mph speed limit in open wetland units, except: *Option 1:* no boating in one unit *Option 2:* no boating in West Marsh & Swan Lake	No boats March 1 to August 1. Boat operation during remainder of the year would be restricted to non-motorized boats & boats with electric motors
- Camping	few restrictions	camping limited to designated areas	camping would be limited to designated areas, and only in fully contained units	no camping
- Road Closures	existing	existing	existing closures, plus closure of North Road & Willow Dike Road	existing, plus limited additional closures

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	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**
PUBLIC USE MGT. Hunting - Wetland Units Open to Waterfowl Hunting	All units north of Division Road, Indian Lakes, along D-Line Canal, & Battleground Marsh (occasional)	All units north of Division Road, & 40% of wetland-habitat in Fallon NWR (on rare occasions).	*Option 1:* All units north of Div. Road (except Lead Lake & West Marsh), & along D-Line Canal (Indian Lakes not in boundary) *Option 2:* All units north of Div. Road & along D-Line Canal (Indian Lakes not in boundary)	All units north of Division Road (except Goose Lake, South Nutgrass, Swan Check, and Tule Lake)
- Days/Times	7 days/week, all day	7 days/week, all day	7 days/week, all day	7 days/week, until noon
- Special Features	Few restrictions, airboats & other boats permitted in open area; camping opportunities would abound	Similar to Alternative A, except that additional regulations would be imposed; camping available, but restrictive	*Option 2:* Addition of a primitive hunt area (remote location, walk-in only); limited camping available	Enhanced opportunities for hunters willing to walk-in or use non-motorized craft
Environmental Education Interpretation & Wildlife Observation/ Photography				
- Facilities	Dirt roads, boat ramps, 2 portable toilets	Same as Alternative A and: - visitor contact station & environmental educ. center - outdoor classroom - all-weather tour route - constructed wetlands - boardwalks and towers - trail at visitor contact station - modern restrooms - interpretive signs	Same as Alternative B and: - outdoor classroom in Stillwater Marsh - interpretive kiosks - wildlife observation trails (in marsh and along Carson River)	Same as Alternative C, and: - enhanced visitor facility at Stillwater Point Reservoir - additional trails
- On-site Environmental Education & Interpretation Program and Opportunities	Moderate, but limited by lack of facilities & from no separation from hunting	Enhanced, but only limited separation from hunting (none in Stillwater Marsh)	Much enhanced by facilities and designated site for environmental education outside of the hunt area	Greatly enhanced by facilities, designated area for non-hunting activities
- Off-site Environmental Education Program	Moderate	Improved over Alternative A	Same as Alternative B	Improved over Alternative C
- Observation & Photography Opportunities	Opportunistic (roads and a crude map are provided)	Enhanced by improved facilities	Greatly enhanced by facilities & a designated area for non-hunting activities (under Option 1)	Greatly enhanced by facilities & a designated area for non-hunting activities
Fishing	Permitted	Not permitted	Not permitted	Not permitted
Cultural Resources Mgt.	Basic protection measures	Basic protection measures	Basic protection measures, goals and objectives for cultural resources, & a staff archeologist	Same as Alternative C
Anaho Island NWR	Monitoring of colony nesters	Same as Alternative A	Same as Alternative A	Same as Alternative A

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3.3.1.1 Features and Assumptions Common to All Alternatives

All alternatives contain several common features and assumptions, which would be part of the comprehensive conservation plan regardless of alternative selected for implementation. Such features and assumptions are presented below to reduce redundancy of the individual alternative descriptions.

Water-Rights Acquisition Program

- A long-term average of 14,000 acres of primary wetland-habitat would be sustained on Stillwater NWR, and the Service would continue to explore the possibility of a coordinated approach to managing water for the Lahontan Valley wetlands.

- The water-rights acquisition program would continue according to the program outlined in Alternative 5 of the WRAP EIS and ROD. Stillwater NWR is anticipated to eventually have an average of 70,000 acre-feet of water available to sustain a long-term average of 14,000 acres of primary wetland-habitat. This would include about 35,000 acre-feet/year from the acquisition of 42,000 acre-feet of water rights (acquired at 3.5 acre-feet/acre of water rights and transferred to the wetlands at the rate of 2.99 acre-feet/acre).

- The land disposal program that is being developed will be incorporated into the comprehensive conservation plan. Public Law 105-277, the Omnibus Consolidated and Emergency Supplemental Appropriations Act of 1999, established a permanent authorization for the Service to sell land and interests in lands (other than surface water rights) acquired through the Service's water-rights acquisition program for Lahontan Valley wetlands pursuant to Section 206 of Public Law 101-618. The sales proceeds must be deposited into the Lahontan Valley and Pyramid Lake Fish and Wildlife Fund and used for additional wetland water purchases.

  The Service is currently considering whether to sell acquired lands that are outside the refuge boundary. In December 1998, through a series of meetings with interested organizations and agencies, the Service began a scoping process to develop and analyze a proposed land sales action and alternatives. The proposed land sales program is separate from the actions analyzed in this Draft EIS, would not affect any lands acquired within the Stillwater NWR boundary, and would only be implemented after the appropriate environmental analysis and decision document have been completed. It is anticipated the Service's land sales planning efforts will continue through calendar year 2000, with implementation in 2001.

- Projected annual expenditures related to the water-rights acquisition program would be the same for all alternatives. According to estimates provided in the WRAP EIS (USFWS 1996a), Stillwater NWR's portion of the annual operation and maintenance costs, and costs of groundwater pumping and leasing water rights would be an estimated average of $1.6 to $1.8 million/year. This includes an estimated annual operation and maintenance

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(O&M) cost for delivering 42,000 acre-feet/year of water (i.e., completion of the water-rights acquisition program) of about $410,000/year, assuming the 1999 rate of $33.90/water-righted acre. This is a conservative estimate. In reality, operation and maintenance costs have increased from $21.40/water-righted acre in 1990 to $35.00/water-righted acre in 2000. At that rate, a reasonable projection of operation charges at the completion of the water-rights acquisition program (an estimated 15 to 20 years) would be in excess of $1.1 million. Other projected costs do not include adjustments for inflation. Also, leasing costs could range from $0 up to as high as $3.9 million in any given year. The projected annual costs identified above assumed an average of $1.9 million/year.

Laws, Regulations, and Policy

- Threatened and endangered species of plants and animals would be protected under the Endangered Species Act.
- In compliance with the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990, any retrofitting of existing facilities or new construction for public use would include assessment of and adherence to specific guidance outlined in these mandates.
- Cultural and historic resources would be managed in accordance with applicable laws and memorandums of understanding (see earlier sections).
- The Service would comply with all applicable Federal laws and regulations.
- Terms would be used as defined in the Glossary, except as modified through Service policy and further evaluations of the definitions.

3.3.1.2 Features And Assumptions Common to All Action Alternatives

Boundary Revision

- The Indian Lakes area would not be added to Stillwater NWR(USFWS 1996c).

Wildlife Conservation

- The focus of refuge management would be conserving native fish, wildlife, and plants, and providing opportunities for compatible wildlife-dependent recreation. Other uses may be provided if the Service finds them to be an appropriate use of the refuge and ensures that they are compatible with refuge purposes, including assurances that their management would not divert funding and staff away from the first and second priorities listed above.
- Introduction of species not native to any refuge would be prohibited, except for biological control agents that may, after proper testing and approval by the U.S. Department of

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Agriculture - Technical Advisory Group for the Biological Control of Weeds, be released to control other, nonnative invasive species. To the extent possible, local (i.e., Lahontan Valley) sources of plant material would be used and out-of-state sources would be avoided.

Public Use Management

- Fishing would not be permitted primarily due to the high level of mercury contamination in the Lahontan Valley, for which an advisory has been issued by the State of Nevada noting that eating any fish caught in the Lahontan Valley is not safe. Further concerns involve potential conflicts with wetland water-management for waterfowl, other waterbirds, and other wetland wildlife, and disturbance to nesting waterbirds during the breeding season. In the event that the health advisory is lifted, fishing would be reevaluated.

- Bicycles and horses would be permitted only on roads open to vehicular traffic.

Changes in Road Status in the Area now within Stillwater WMA and Fallon NWR

Roads that are on Federal lands within Stillwater WMA and Fallon NWR will be evaluated based on a number of criteria to determine if there is sufficient justification to keep certain roads or segments of roads open for vehicular use (this would not apply to Alternative B). For some roads remaining open to vehicular use, seasonal or periodic closures may be necessary (e.g., during inclement weather to protect road beds). To maintain the remote and rugged nature of the area now encompassed within Stillwater WMA and Fallon NWR, all open roads (except the Indian Lakes Road and the road accessing Battleground Point) would be two-track roads, and a maximum road density would be determined for this area. To the greatest extent possible, only one road would provide access to a given area of the refuge.

Roads may remain open to public vehicular use if the following criteria are met:

1. Vehicle access to a particular site is needed to support a wildlife-dependent recreational use, based on previously determined needs. Providing access for nonwildlife-dependent recreation will generally not warrant keeping a road open.

2. Traffic has minimal disturbance to wildlife populations.

3. Road has minimal impact on wildlife and fish habitat (e.g., sedimentation, transport of noxious weed seeds).

4. Road meets basic saftey standards for road type.

5. Benefits of keeping a road or portion of a road open is outweighed by potential adverse impacts to reptiles (e.g., commercial and other collecting), unique and

sensitive habitats (e.g., access to dunes, roads in riparian areas), and cultural resources (e.g., looting).

6. Funding and staffing is available to make periodic repairs and to provide adequate law enforcement needed to minimize adverse impacts to wildlife, habitat, and cultural resources (e.g., impacts of roads on riparian habitats, off-road vehicle impacts to dunes, collection of lizards).

7. Road is needed to access a private, county, or state inholding. If this criterion is met for a particular road, but one or more of the above criteria are not met for the same road, the Service will work with the appropriate parties to minize the potential adverse impacts that may result from keeping the road open.

Wilderness Review

- Anaho Island was proposed for wilderness designation as a roadless island in 1974. Therefore, it will be managed to preserve its wilderness character, which is consistent with its current management. Although the Service excercises primary jurisdiction over the island, no major deviations from current management practices will occur without the consent of and coordination with the Pyramid Lake Paiute Tribe, as per Resolution No. 19-90 of the Pyramid Lake Paiute Tribal Council and Public Law 101-618. (see also Section 3.2.2.1.6)

- Upon the establishment of an approved refuge boundary following this planning process, the wilderness potential of the lands within the new Stillwater NWR/Fallon NWR boundary would be studied further. The northern and central part of boundary-revision study area meets the criteria of potential wilderness (Section 3.2.2.1.6). The chain of sand dunes along the northern part of the study area is over 14,000 acres and apparently formed by wind action blowing sediments deposited by the Carson River at its terminus. These dunes are unvegetated and unstable, meaning that they are currently active and mobile. A recent inventory revealed the possibility that two species of dune beetles may be endemic to this unique sand formation (Rust 1998). There are few roads through this area, no improved roads, and they are only occasionally used by Service personnel, researchers, and refuge visitors. Conducting a wilderness review during this planning process was premature because the boundaries of the refuges could potentially change.

Adaptive Management

A three-tiered approach to monitoring would be implemented under any of the action alternatives selected. The first level would involve tracking the implementation of strategies outlined under the alternative selected for implementation. This is important because evaluating the effectiveness of strategies in achieving objectives assumes that the prescribed strategies, as a program, are carried out. If strategies are not implemented as prescribed, this would be considered in assessing the effectiveness of the particular alternative's management program.

For the strategies that are implemented, periodic analysis of monitoring data would be used to evaluate the effectiveness of these strategies in achieving objectives. This second level of monitoring is the traditional focus of monitoring programs and would by the most detailed. If, through monitoring, it is found that a particular objective or set of objectives is not being achieved by carrying out a prescribed strategy, it may be necessary to adjust the strategy or identify a different strategy. In some cases, this may require additional NEPA analysis.

Achievement of objectives would also be evaluated against the refuge goals and purposes under which they were developed to ascertain the appropriateness of the objectives. Under each alternative, it is assumed that achievement of objectives would result in the accomplishment of refuge goals and purposes. Because this involves assumptions based on professional judgement, resource management principles, and scientific information, Refuge staff must periodically evaluate these assumptions. If a particular set of objectives are determined to be achieved through monitoring (previous paragraph), yet they do not appear to be contributing to refuge goal accomplishment, adjustments to the objective may be needed. If changes to objectives are substantive and outside the scope established by the alternative's guiding principles, this Draft EIS may have to be modified through further NEPA analysis and public involvement. Substantive changes to goals, subgoals, and definitions of key terms would be outside the scope of adaptive management, and such changes may require a new plan to be developed.

Step-down Management Plans

Detailed, step-down management plans would be developed for the following, each of which would be reviewed every 3 to 5 years unless otherwise noted:

- Habitat management
- Water management (prepared annually)
- Fire management
- Integrated pest management plan
- Biological monitoring program
- Public-use management
- Hunt plan (prepared annually)
- Contingency/emergency plan for mosquito abatement

3.3.2 Alternatives Considered, but Not Studied in Detail

The Service considered several other approaches to managing wildlife and habitat on Stillwater NWR. However, because these approaches were not found to be appropriate or realistic, they were not evaluated in detail.

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3.3.2.1 Boundary Revision to Include Carson River and Sand Dune Complex

One of the other boundary revisions that was considered in addition to those identified and considered in detail in this Draft EIS was a boundary of Stillwater NWR that would have included the Carson River corridor and the entire sand dune complex along the southern edge of the Carson Sink, similar to Alternatives C and D. However, the lands between the Carson River corridor and the existing western boundary of Stillwater NWR south of the sand dune complex would not be included under this alternative. It was not considered in detail for a combination of reasons. It is very similar to alternative C, the only difference being the 21,000-acre block of primarily saltdesert shrub and playa habitat, which is a major component of the natural biological diversity in the Lahontan Valley. Under this alternative, Stillwater NWR would be 'U' shaped and the Indian Lakes Road that runs between the Carson River Corridor and the existing Stillwater NWR would not be contained within the refuge, which would make administration and law enforcement more difficult. The area is mostly Federally owned.

3.3.2.2 Custodial Maintenance

One interpretation of natural biological diversity is the biological diversity that would result from abandoning all active management of Stillwater NWR and disallowing any public use on the refuge (i.e., absence of any current human influences within the boundaries of Stillwater NWR). This view of natural, as it pertains to requirements of Public Law 101-618 and other management authorities, is flawed for several reasons. First, the major human influences that affect the animal and plant communities on Stillwater NWR occur well outside the boundaries of the refuge (closing the refuge would not resolve these factors). For instance, the water that reaches the refuge is highly controlled and otherwise affected by people throughout the Carson River watershed. Secondly, existing conditions on the refuge are a consequence of past human activities on and off the refuge, including dike construction, mining that resulted in substantial deposits of mercury on the refuge, and the introduction of saltcedar which is now prevalent on the refuge. Therefore, the assumption that a hands-off approach would result in natural biological diversity is unrealistic.

3.3.2.3 Full Restoration of the Natural Hydrology of Stillwater Marsh

The most direct approach to restoring natural biodiversity within Stillwater NWR would be to restore the natural volume and timing of wetland inflows. An assumption of this alternative is that a natural biological diversity in Stillwater Marsh would best be achieved by restoring natural water-flow volumes, timing, patterns, and chemistry. This alternative would fulfill the purposes of Stillwater NWR, but could have large, significant impacts to areas outside the refuge; would be expensive; and is considered impractical.

A major requirement would be to restore Stillwater Slough and to increase the canal capacity leading into Stillwater Slough so that the system could accommodate a flow of at least 4,000 cubic feet pre second (cfs), but could be much higher. This would require major reconfiguration and construction of the canals below Lahontan Reservoir as well as major modifications to the Lahontan Reservoir dam, but would also contribute to minimizing flood potential in the Fallon area.

An estimated long-term average application rate of about 15-20 acre-feet/acre of wetland-habitat/year would be needed, which would allow most of the water to flow through the marsh, thereby maintaining a relatively fresh marsh. To sustain a long-term average of 14,000 acres of wetland-habitat in Stillwater Marsh, a long-term average of approximately 200,000 acre-feet/year would be needed. This strategy would be necessary to maintain water chemsitry in the marsh similar to that which occurred under natural conditions. To attain these flow rates, additional water-rights would have to be purchased.

Restoring the natural shoreline configuration and geomorphology of Stillwater Marsh to natural conditions would require the removal of all dikes, canals, and water control structures, to the extent needed to sustain a long-term average of 14,000 acres of wetland-habitat in the historic marsh under this approach. The 1937 topographic map, created prior to any development, could be used to determine the extent of the historic marsh. Deep-water areas, including the natural path of Stillwater Slough through the marsh, would have to be restored. This may require some excavation, but flood flows would assist in this effort. Some of the roads associated with dikes could be replaced with bridges.

This approach would be impractical and unreasonable for a variety of reasons, including: (1) major reconstruction of Lahontan Reservoir and other infrastructure of the Newlands Project does not appear to be reasonable; (2) restoration of the natural hydrology without addressing other factors limiting the achievement of natural biological diversity in Stillwater Marsh (e.g., introduced species, a great many off-refuge factors affecting migratory bird populations and movements) would not result in the full achievement of natural biodiversity; and (3) a significant increase in water-rights purchases would conflict with the WRAP EIS.

3.3.2.4 Reduced Wetland Water Demand

Consideration was given to developing an alternative that would lower the annual wetland water demand considerably below 5 acre-feet/acre/year. Alternative B provides an alternative that could potentially reduce the wetland water demand by a small amount. Examining an alternative water management scenario that would reduce the demand far below 5 acre-feet/acre/year was not considered in detail for the following reasons. The restoration of natural biological diversity is a major purpose for which Stillwater NWR wetlands are to be managed. This mandate is consistent with the fulfillment of international treaty obligations, which is another purpose of Stillwater NWR. The native biotic communities of Stillwater Marsh evolved under a wetland hydrologic regime that entailed large volumes of water flowing into and through the marsh.

Using estimates provided in Kerley et al. (1993), the average amount of water flowing into Stillwater Marsh would have been in the neighborhood of 15 to 20 acre-feet/acre/year or more, which would have resulted in an average of two-thirds to three-quarters of the inflow water passing through the marsh and out into the Carson Sink. This estimate is based on the following assumptions derived from Kerley et al. (1993): an average inflow into Stillwater Marsh of 270,000 acre-feet, (2) an average of 15,000 acres of wetland habitat in Stillwater Marsh, and (3) an estimated evapotranspiration rate of 5 acre-feet/acre/year. Rarely would the annual flow into Stillwater Marsh have been less than 100,000 acre-feet/year, and under this situation, the volume of inflow per acre of wetland-habitat would have exceeded 5 acre-feet/acre/year. Thus, it would be unreasonable to design a water management program with a wetland inflow demand that was less than the annual evapotranspiration rate (i.e., less than 5 acre-feet/acre/year).

3.3.2.5 Closure of Stillwater Marsh during the Breeding Season

Because of concerns about the effects that people have on wildlife during the breeding season, it was suggested that the entire Stillwater Marsh be closed to public access during the breeding season. However, most people that visit the refuge for purposes of birdwatching, environmental education, and touring the refuge use the refuge during the spring and summer. Excluding people from the marsh at this time would forego a tremendous opportunity to share with people the diversity and abundance of wildlife of the refuge and the importance of conserving wetland-habitat in Nevada.

3.3.2.6 Sanctuary in the Highest Quality Wetland Units

In evaluating potential configurations of a sanctuary, general public-use area, and hunting area, numerous scenarios were delineated on maps. Given the Refuge System's fundamental mission of wildlife conservation and directive to consider the needs of wildlife first in all decisions, several scenarios were developed that would dedicate the best available wetland-habitat on the refuge to wildlife as a sanctuary. Alternative locations for a sanctuary were considered in part because the current sanctuary encompasses less-than-optimum wetland-habitat. The wetlands were constructed in the 1950s and the largest wetland unit is the refuge's primary regulating reservoir, These wetlands have different characteristics than the natural marsh.

One configuration was delineated that represented a near-ideal situation for wildlife. Under this scenario, Nutgrass Lake, Goose Lake, and Pintail Bay would be designated as sanctuary. A slightly different scenario would be to close Nutgrass Lake, Swan Lake, and Pintail Bay, which would provide the greatest protection for cultural resources of any of the scenarios considered. However, because an estimated 60 to 70 percent of the waterfowl hunting occurs in Nutgrass Lake, Goose Lake, and Pintail Bay, this alternative was not studied in detail. Several other alternatives were studied in detail that would ensure at least some high-quality habitat would be available to birds in the historic marsh but that would have relatively few effects to hunting opportunities (e.g., Alternatives C and D).

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3.3.2.7 Walk-in–only Hunt Area at the Northeast End of Stillwater Marsh

An alternative to Alternative C's Option 2 walk-in hunt location was considered as a replacement to the locations proposed under this option. Rather than locate the walk-in-only hunt area in West Marsh (Willow and Millen Lakes) and Swan Lake, consideration was given to delineating Pintail Bay and the northern part of the North Nutgrass unit. This was deemed a less desirable location for a walk-in-only hunt area for several reasons. Pintail Bay and northern end of Nutgrass Lake have fairly simple shorelines (e.g., very few peninsulas and islands) as compared to the complex shorelines of West Marsh and Swan Lake, which could result in a relatively small number of walk-in hunters disturbing waterfowl over a large area. The long southern edge of the walk-in-only boundary in North Nutgrass could be approached by boaters, which would affect waterfowl well into the walk-in-only hunt area. This would provide fewer opportunities to hunters in the walk-in-only hunt areas (due to easily flushed birds) than could be provided in West Marsh and Swan Lake. Furthermore, proportionally far less of the area would remain relatively undisturbed, which would have fewer benefits to waterbirds.

3.4 ALTERNATIVES CONSIDERED IN DETAIL

3.4.A ALTERNATIVE A - No Action Alternative

Under this alternative, it is assumed that management of Stillwater NWR, Stillwater WMA, and Fallon NWR would generally follow the goals, objectives, and strategies outlined in the *1987 Management Plan for Stillwater Wildlife Management Area*, published in Volume II of the WRAP EIS(USFWS 1996a). This plan was founded on the 1948 Tripartite Agreement, as amended. Under an extension to the Tripartite Agreement (USBOR 2000), the Service would continue to coordinate management of Stillwater WMA with the Bureau of Reclamation (Section 3.2.2.1.1). A major part of this alternative's program, not covered in the 1987 plan, is the continuation of the Service's water-rights acquisition program (Section 3.2.1.3.5). This would be the same for all alternatives.

Management would focus on providing for the needs of key wildlife species. Of particular emphasis under this alternative would be providing high-quality breeding habitat for waterfowl and other waterbirds. A considerable amount of wetland-habitat would be maintained during the fall and winter as well, to provide habitat for waterfowl and to provide opportunities for waterfowl hunting. The existing boundaries of Stillwater NWR, Stillwater WMA, and Fallon NWR would continue under this alternative, but most of the management emphasis would be given to wetland management on Stillwater NWR.

Hunting would continue as the priority public use of the area. Opportunities for environmental education, wildlife observation, fishing, and other uses would also being provided, but very few facilities would be provided for these other uses. Commercial livestock grazing, muskrat trapping, and fishing would continue much as it has in the past.

Anaho Island NWR would continue to be managed much as it has in the recent past, with an emphasis on protecting and monitoring the nesting colony of American white pelicans and other colony-nesting birds that use the island.

Because this alternative is based on the 1948 Tripartite Agreement and is not consistent with Public Law 101-618 and the Refuge System Administration Act, it would not be possible to implement this alternative as written. As the No Action Alternative, it provides a baseline for comparing the action alternatives (Alternatives B, C, and D).

Some of the major headings under Alternative B are as follows:

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Broad Management Direction	3-38
Stillwater NWR, Stillwater WMA, and Fallon NWR	
Boundaries	3-39
Wildlife and Habitat Management	3-41
Public-Use Management	3-50
Anaho Island NWR	3-55
Other Program Areas	3-57

3.4.A.1 Broad Management Direction

3.4.A.1.1 Refuge and WMA Purposes

Stillwater NWR/WMA, and part of Fallon NWR (1948 Tripartite Agreement)

1. Conservation, rehabilitation, and management of wildlife, and its resources and habitat, including the operation and maintenance of a wildlife sanctuary.

2. Operation and maintenance of a public shooting ground.

The following would be managed commensurate with the primary purposes.

1. Fur production, particularly muskrat production.

2. Livestock grazing.

Fallon NWR (Executive Order 5606)

1. Provide a sanctuary and breeding ground for birds and other wildlife.

Anaho Island NWR (Executive Order 1819)

1. Provide a preserve and breeding ground for native birds.

3.4.A.1.2 Refuge Goals and Other Programs

The wildlife management and public-use programs are the focus of refuge management. As such, they are the focus of management goals. Other programs provide support to achieve these goals and ensure the protection of other resources, compliance with laws and safety regulations, and the administration of the complex.

Stillwater NWR/WMA and Fallon NWR Goals

A. Provide an average of 14,000 acres of wetland nesting habitats including stands of hardstem bulrush.

B. Provide a fall and spring resting, feeding, and staging area of 14,000 wetland-habitat acres for migrating waterbirds.

C. Provide a variety of habitats for wildlife diversity.

D. Improve the quality of existing wildlife/wildland recreation and enhance opportunities for interpretation and environmental education.

Basis of Goals: The above goals were generally developed under the purposes for which Stillwater NWR and Stillwater WMA were established (1948 Tripartite Agreement). They support the goals of the Refuge System, outlined in Service policy that existed at the time (Section 3.2.1.1.2). The refuge and the management area goals that affect management of Fallon NWR, especially in regards to breeding habitat, generally support the purposes for which this refuge was established.

Anaho Island NWR Goals

A. Protect and perpetuate colonial-nesting birds and other migratory birds.

Basis of Goals: Anaho Island NWR was established to protect the American white pelican nesting colony and other colonies of nesting birds. This goal supports the purposes for which the refuge was established.

Other Programs and Areas of Emphasis

In addition to refuge goals that generally outline how refuges are to be managed to achieve the purposes for which they were established, many refuges have other programs that are peripheral to the core programs (i.e., wildlife and wildlife-dependent recreation). The programs that would be part of this alternative are listed below and described in more detail later. Many of the programs are integrally related to the core programs.

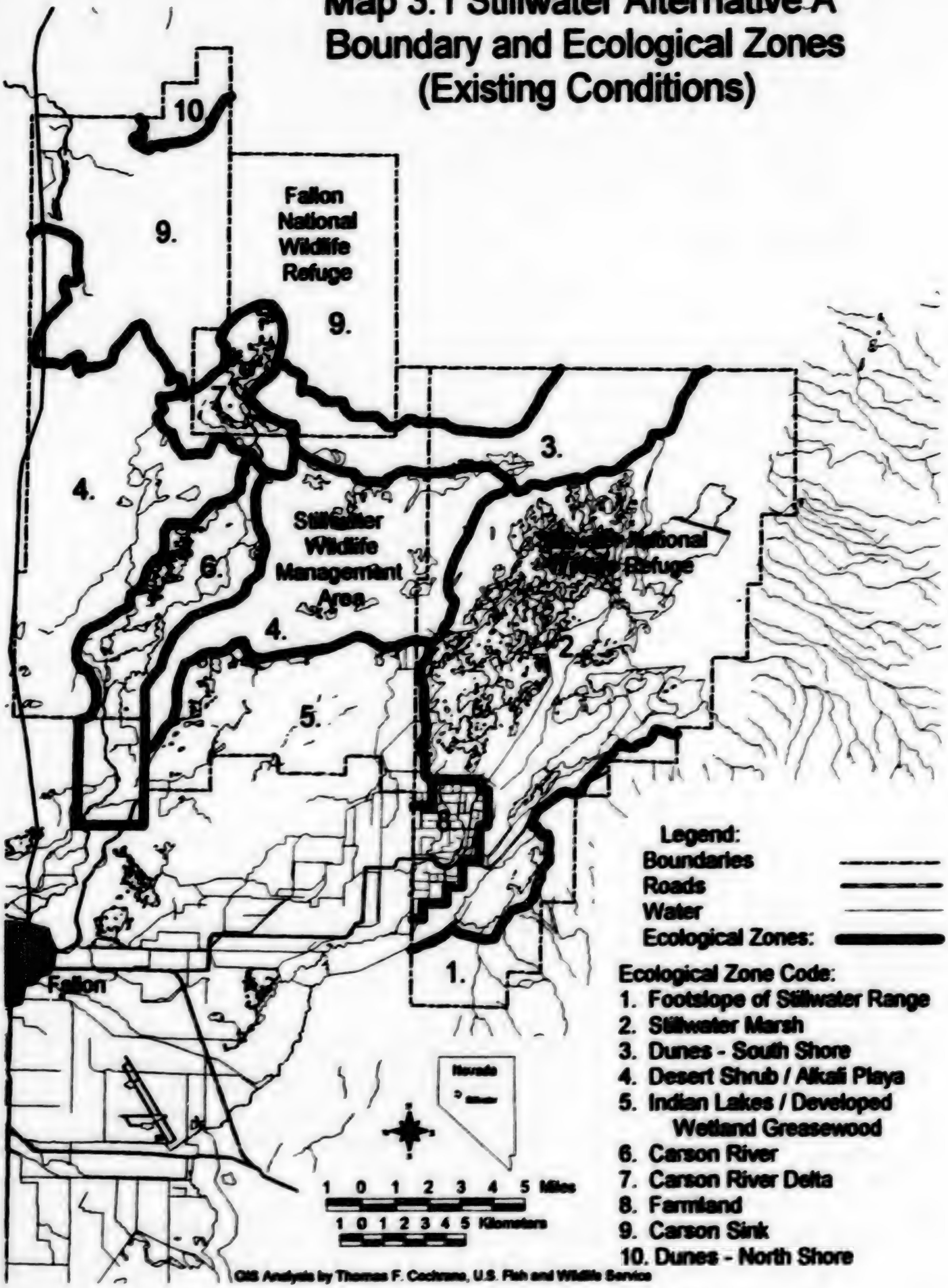
- Commercial Use Program
- Outreach Program
- Partnerships and Other Cooperative Efforts
- Water-Rights Acquisition and Land Disposal Program
- Fire Management
- Cultural Resource Management
- Monitoring and Research Program
- Facilities Maintenance and Safety
- Law Enforcement
- Administration

3.4.A.2 Stillwater NWR, Stillwater WMA, and Fallon NWR

3.4.A.2.1 Boundaries

Under this alternative, the existing boundaries of Stillwater NWR, Stillwater WMA, and Fallon NWR would continue into the future (Map 3.1). The boundary of Stillwater WMA, according to the Tripartite Agreement, encompasses all the land now within Stillwater WMA, Stillwater NWR, and the contiguous portion of Fallon NWR. Stillwater NWR originally comprised the sanctuary area south of Division Road, but the boundaries of the refuge were expanded in 1990 under Public Law 101-618.

Map 3.1 Stillwater Alternative A Boundary and Ecological Zones (Existing Conditions)



GIS Analysis by Thomas F. Cochrane, U.S. Fish and Wildlife Service

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The ecological zones depicted in Map 3.1 show the general types of habitats that are encompassed in the existing boundaries of Stillwater NWR, Stillwater WMA, and Fallon NWR.

3.4.A.2.2 Management Program

This alternative would continue the management strategies that were in place prior to Public Law 101-618. Most of the following guiding principles, objectives and their basis, and strategies were taken directly from the *1987 Management Plan for Stillwater Wildlife Management Area*, which was founded on the 1948 Tripartite Agreement. Because the average of 14,000 acres of wetland-habitat targeted in the 1987 plan is consistent with Stillwater NWR/WMA's portion of the 25,000-acre target for primary Lahontan Valley wetlands (subsection 206(a), Public Law 101-618), the water management strategies in the 1987 plan are consistent with the Service's water-rights acquisition program outlined in the WRAP EIS/ROD. The 1987 plan (Stillwater NWR files, and printed as Appendix 2 of the WRAP EIS), covers Stillwater NWR/WMA and the contiguous, southern part of Fallon NWR.

3.4.A.2.2.1 Fish, Wildlife, and Habitat Management

Guiding Principles

The following principles would guide the management of fish, wildlife, and habitat under this alternative.

Habitat Conditions. This alternative would focus on providing the habitat needs of key species and groups of species. As such, the Service would maintain a key species approach to managing Stillwater NWR, Stillwater WMA and Fallon NWR. The overall mission for Stillwater NWR, Stillwater WMA and Fallon NWR under this alternative would be to provide habitat for nesting birds, and spring and fall migrants, with an emphasis on waterfowl, and a growing emphasis on shorebirds. Those of special interest would, according to the 1987 plan, include redheads, canvasbacks, tundra swans, white-faced ibis, white pelicans, bald eagles, and peregrine falcons. In general, wildlife management and public use management would be emphasized on Stillwater NWR, and livestock grazing would be the emphasis on the remainder of the area. Under a 1960 working agreement between the Service and the Nevada State Board of Fish and Game Commissioners, lands within the area now within Stillwater WMA and Fallon NWR were to be developed for livestock grazing with collateral benefits to wildlife, as compared to the area now within Stillwater NWR, which was to be managed for wildlife with collateral benefits to livestock grazing (Nevada State Board of Fish and Game Commissioners and USFWS 1960).

General Approach to Producing these Habitat Conditions. In developing annual water plans, the order of priority for water use would be to (1) sustain a high survival of emergent vegetation through drought years, (2) provide high-quality nesting and brooding habitat and to maintain water levels during the breeding season, (3) provide circulation of water to promote growth of sago pondweed, and (4) refill wetland units after draining them to dump salts or kill carp. With respect to managing for particular species, habitat management priorities would be as follows:

1. Redhead production habitat;
2. Redhead and canvasback maintenance habitat;
3. Production habitat for other waterfowl;
4. Maintenance habitat for other waterfowl, especially tundra swans;
5. Production habitat for other waterbirds;
6. Maintenance habitat for other waterbirds, bald eagles, and peregrine falcons; and
7. Maximum habitat diversity for other wildlife.

Parallel with the guiding principles outlined above, habitat management would focus on the management tools that would most effectively produce the habitat conditions to meet the particular needs of the species or species' group of interest. Water management and prescribed burning would be the primary management tools, with a focus on producing submergent aquatic vegetation as well as summer drawdowns to promote moist soil vegetation. Water would also be used to maintain deep emergent vegetation. Other tools could include controlled livestock grazing, and possibly herbicides and explosives.

Monitoring. Long-term data sets would be continued and these would be periodically analyzed.

Objectives and Strategies

The overall mission of Stillwater NWR, Stillwater WMA and Fallon NWR under this alternative would be to provide habitat for nesting birds, and spring and fall migrants, with an emphasis on waterfowl and shorebirds. Those of special interest would include redheads, canvasbacks, tundra swans, white-faced ibis, bald eagles, and peregrine falcons.

For each objective or series of objectives for Stillwater NWR, Stillwater WMA, and Fallon NWR, the basis for developing the alternative, strategies to meet the alternative, and monitoring elements are identified. The basis of objectives, adopted from the 1987 plan, explain the rationale upon which the objectives were developed.

Goal A: Provide an average of 14,000 acres of wetland nesting habitats including stands of hardstem bulrush.

General Strategies to Achieve Goal: Water management would be the primary means to manage vegetation. A major strategy would be to continue acquiring water and water rights, as outlined in the WRAP EIS, until sufficient water and water rights are obtained. Under this alternative, the Service would call for purchased and leased water within the schedule outlined below, which is based on the hydrograph presented in the WRAP EIS (USFWS 1996a). The delivery schedule would not be influenced by the inflow of drainwater, which would flow into the refuge based on Newlands Project operations, or the inflow of excess water during years of controlled releases or spills from Lahontan Reservoir.

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	40-55%	40-55%	10-15%
Full water-year	0%	40-50%	40-50%	10-15%
Spill year	0%	20-40%	50-60%	20-40%

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In developing annual water plans, the order of priority for water use would be to (1) sustain a high survival of emergent vegetation through drought years, (2) provide high-quality nesting and brooding habitat and to maintain water levels during the breeding season, (3) provide circulation of water to promote growth of sago pondweed, and (4) refill wetland units after draining them to dump salts or to kill carp.

Water would be controlled by the existing canals, diking, and other infrastructure. Nesting islands would be constructed. Extremely high or low flows of water through wetland units would be avoided by use of bypass canals. Open channels would be maintained by fire or physical means in cattail and hardstem bulrush stands to permit movement of water and wildlife. Movable low-lift pumps should be used to move water from one unit to another where lack of elevation prevents drainage.

The Refuge Manager would continue to work with the Bureau of Reclamation and TCID, so that the available of water would be delivered and used efficiently. Coordination with the Ecological Service branch of the Service would continue to address up-river water quality issues and to address impacts to wetlands brought about by Service actions aimed at enhancing endangered species.

Priorities for any excess water would be to (1) flush salts from units with high duck production, (2) flush salts from other impoundments, (3) flood seldom used or abandoned impoundments, and (4) irrigate pastures.

Monitoring Elements: Acreage of wetland-habitat during the breeding season, April-August.

Objective A.1: Over a ten-year period, provide habitat capable of producing an annual average of 2,500 redhead ducks to flight stage.

Basis of Objective: Stillwater Marsh has historically been a producer of redheads due to the presence of relatively large and deep wetland-habitat, for which the infrastructure was developed.

Strategies to Achieve Objective: Strategies for enhancing redhead production in the 1987 plan focused on acquiring additional water and infrastructure improvements (above). The only habitat management strategy was to use available water in drought years to maintain the viability of emergent vegetation until the drought period is over. In scarce water years, attempts to maintain water levels for nesting would be abandoned.

Monitoring Elements: Annual production of redheads to flight stage, and acreage and distribution of hardstem bulrush and other deep emergent vegetation.

Objective A.2: Produce safe nesting habitats of hardstem bulrush and associated feeding areas in order to produce, over a five-year period, an average of 1,000 white-faced ibis to flight stage.

Basis of Objective: The objective was developed to support regional resource priorities to enhance, protect, and preserve sensitive species and their habitats. Although Carson Lake has traditionally received most of the white-faced ibis use in the Lahontan Valley, due to more attractive habitat at Carson Lake, Stillwater Marsh is an important area for white-faced ibis.

Strategies to Achieve Objective: Strategies would be the same as for redhead production, with a few additional actions. Hardstem bulrush rootstocks would be transplanted to suitable sites. Open water and movement of water would be maintained in colony sites, through the use of fire or physical means. Through the use of law enforcement, posting and road closures, Human caused disturbance from boats, vehicles, and foot travel would be discouraged during the nesting season. When excess water is available, it would be used to flood pastures or dry units to create feeding sites adjacent to white-faced ibis nesting colonies.

Monitoring Elements: Numbers of ibis produced and acreage of hardstem bulrush.

Objective A.3: To perpetuate wetland habitats sufficient in size and quality to sustain production of 10,000 shore/marsh/waterbirds per year. This is only slightly below historic numbers. Species included are: coot, long-billed curlew, snowy plover, avocet, black-necked stilt, grebes, herons, egrets, and rails.

Basis of Objective: This objective is in keeping with the Service's goal of providing for a diversity of habitats and species on all units of the Refuge System. Stillwater NWR and Stillwater WMA have traditionally produced large numbers of these birds.

Strategies to Achieve Objective: Under this alternative, an assumption would be that carrying out strategies and meeting production objectives of redhead and white-faced ibis would ensure the retention of the bulk of production for species nesting over water (see above strategies). Meeting objectives for maintaining hardstem bulrush would also perpetuate alkali bulrush. At least one dense, mature stand of hardstem bulrush would be maintained in each wetland unit.

Water would be managed to maintain shallow, nonfluctuating water depths in nesting areas to promote growth of submergent vegetation sufficient in amount and density to support floating nests. Extremely high or low flows through impoundments will be avoided by use of bypass canals. Instead of using a single water control structure for inflows into impoundments, all flow structures will be utilized to improve water clarity and circulation.

Mudflats would be provided during years of low water in at least one wetland unit to meet shorebird objectives. In most cases, however, the use of water specifically to manage for species using mudflats would be at cross purposes to meeting objectives for over-water nesters and could increase the potential for botulism outbreaks. In years of high water inflows, the excess water used to flush salts into alkali flats or the Carson Sink would provide late season nesting habitat for stilts, avocets, snowy plovers, and other shorebirds.

Where lacking, cottonwoods would be planted to maintain tree nesting colonies of herons and egrets.

Monitoring Elements: Combined annual production of shorebirds and other waterbirds.

Objective A.4: Provide waterfowl nesting habitats sufficient in size, quantity, and quality to produce, to flight stage, 5,300 young ducks and geese annually.

Basis of Objective: This objective was based in part on the assessment that, although Stillwater Marsh has traditionally produced more divers than dabblers and although Carson Lake traditionally produces more dabblers than Stillwater Marsh, Stillwater NWR and Stillwater WMA can still contribute to duck production in the Lahontan Valley.

Strategies to Achieve Objective: The strategies for redhead production and water management would be carried out for other ducks as well. The following additional strategies would facilitate nesting by other ducks.

Meeting production objectives for dabbling ducks depends primarily on the management of saltgrass, including water management. This alternative would allow for livestock grazing or prescribed burning to be used in cases where it is thought that saltgrass is becoming too decadent for nest selection by ducks. Some fencing may be in the Stillwater Marsh area may be undertaken to control livestock grazing. Nesting islands would also be constructed. Dabblers also nest under upland shrubs such as iodine bush.

Although meeting the production objective would depend primarily on habitat management, raven control may be implemented. Ravens are thought to be the major predator of waterfowl eggs and the population of ravens appears to have increased in recent years. Some roads would be closed to reduce disturbance to birds nesting along roads or dike roads.

Monitoring Elements: Annual production of ducks and geese, except redhead, to flight stage.

Goal B: Provide a fall and spring resting, feeding, and staging area of 14,000 wetland-habitat acres for migrating waterbirds.

General Strategies to Achieve Goal: The water management strategies identified under Goal A apply equally to this goal.

Monitoring Elements: Wetland-habitat acreage during September-January.

Objective B.1: Provide habitat capable of annually supporting an average of one million redhead and canvasback use-days during a five-year period, with peak populations averaging 20,000 redheads and 25,000 canvasbacks.

Basis of Objective: Redheads have been a focus of management at Stillwater NWR and Stillwater WMA. This area has historically attracted migrating redheads due to the presence of deep water ponds containing abundant amounts of sago pondweed. When adequate water is available, Stillwater Marsh has been the major staging area for redheads and canvasbacks, with up to one-third of these species' total flyway population on the area between mid-October through mid-November.

Strategies to Achieve Objective: Key strategies, outlined in the 1987 plan, would be the acquisition of additional water, improved water-management infrastructure, and efficient use of water, as described in the general strategies under Goal A.

Several actions would be taken to reduce turbidity and increase water circulation as a means to facilitate growth of aquatic vegetation. Larger impoundments would be broken by cross diking to reduce wave action, and hardstem bulrush and cattail root stocks would be transplanted to further reduce scouring and water turbidity caused by winds. Other measures to reduce turbidity include the use of bypass canals around upper wetland units during high flows and control of carp through periodic drawdowns in conjunction with rotenone. Drawdowns would also aerate pond bottoms, further facilitating aquatic production.

To facilitate feeding by diving ducks, production of aquatic vegetation would initially be optimized through retaining water flow. This would be followed by a gradual lowering of wetland-unit water depths during the fall and winter. This could be accomplished as part of draw-down plans for units and to facilitate flushing of salts from lower, more saline units.

Because canvasbacks and redheads are sensitive to disturbance, some additional roads may be closed to reduce access and disturbance, thus increasing duck populations during the hunting season. When flood repairs are made to dikes and access roads, selected routes agreed to by Nevada Division of Wildlife would be left impassable and others closed. The Service would conduct waterfowl identification workshops to reduce the overharvesting of canvasbacks and redheads and the taking of tundra swans without a permit

The existing sanctuary area would be maintained, which means that when all major units are at an ideal level (e.g., about 17,000 acres of wetland-habitat), about 30 percent of the wetland-habitat would be in sanctuary. (The proportional amount to be maintained in sanctuary could be increased to 50 percent as specified in the 1948 Tripartite Agreement.) Assuming a long-term average of about 12,700 acres of wetland-habitat during the hunting season, an estimated 4,500 acres (about 35 percent) of the marsh would be managed as sanctuary. In some recent years, approximately 40 to 50 percent of wetland-habitat has been in sanctuary.

Monitoring Elements: Use days of redheads and canvasbacks per year, and annual aquatic production. Past receipts, water management, and aquatic production records will be examined to provide management information, to determine how to improve water management.

Objective B.2: Provide habitat capable of supporting an annual average of 660,000 tundra swan use-days over a five-year period, with a peak population of 12,000 at least once during this period.

Basis of Objective: Lahontan Valley provides key habitat for tundra swans in Nevada, with an average of over 80 percent of the state's population in Lahontan Valley wetlands.

Strategies to Achieve Objective: Strategies for redhead and canvasback maintenance (Objective B.1) would contribute to this objective, and few separate management strategies designed specifically for tundra swans would be necessary or planned, although minor adjustments may be needed. Because swans tend to stay longer into winter, water flow may have to be maintained through impoundments to prevent ice from covering all food supplies.

Monitoring Elements: Annual use-days of tundra swans.

Objective B.3: Provide habitat capable of supporting, over a five-year period, an annual average of 11,810,000 waterfowl use-days (including redheads and canvasbacks), with peak populations averaging 150,000 and exceeding 200,000 at least once during this period.

Basis of Objective: The targeted use days reflect the use of Stillwater NWR and Stillwater WMA during the period 1974-1983 (prior to this, the area supported up to an average of 25,000,000 use days). Although use of Stillwater Marsh by dabbling ducks can be high at times, this objective is secondary to the prior two objectives because Stillwater Marsh has traditionally held fewer dabbling ducks as compared to Carson Lake where wetland-habitat is generally shallower.

Strategies to Achieve Objective: Some management strategies for waterfowl would be identical to and dependent on those planned for redhead and canvasback maintenance, including maintenance of the existing sanctuary. Other strategies would be employed, but strategies for waterfowl maintenance would only be undertaken if there is sufficient water to first meet higher priority objectives (maintaining water elevations during the breeding season, circulation of water to promote sago pondweed and facilitating availability of sago pondweed during the fall and winter, refilling units after draining them, and sustaining high survival of emergent vegetation).

There are some situations in which water could be used to increase use of the area by migratory waterfowl, especially dabbling ducks and geese. After meeting higher priority goals and objectives, water could be managed to increase use of the area by migrant waterfowl, especially dabbling ducks and geese. This would include drawing down of particular wetland units to encourage growth of alkali weed, Russian thistle, and other annual, seed producing plants, followed by reflooding units in fall to provide food for fall and winter waterfowl. In wetland units providing winter submergent aquatic feed, water depths would be slowly increased during the fall and winter and then allowed to decline during the spring to increase the availability of invertebrate to waterfowl during spring migration. Water levels in units containing little or no submergent aquatic food could be raised to flood bordering saltgrass; it would not be done in units containing sago pondweed or wigeongrass because this would make the submergent vegetation less available to divers. Flows would be managed during the winter to maintain open water for tundra swans and other waterfowl.

East Alkali, Division, and Cattail, and other wetland units can be flooded in the spring (consistent with other objectives) to produce nutgrass stands. This procedure can occasionally produce substantial amounts of food without a large consumption of water during the summer. Teal and other dabblers would be attracted to these areas if reflooded in the fall.

Monitoring Elements: Annual use days and population peaks of ducks and geese.

Objective B.4: Provide feeding habitats and sanctuary to enhance the suitability of the Stillwater Marsh for nesting white-faced ibis, targeting 210,000 use days annually on a five-year average and population peaks that reach 31,000 individuals in two of five years.

Basis of Objective: The objective was developed to support regional resource priorities to enhance, protect, and preserve sensitive species and their habitats. Five-year averages are used instead of annual population goals because annual population targets are unrealistic in a desert environment. Although Carson Lake has traditionally received most of the white-faced ibis use in the Lahontan Valley due to more attractive habitats at Carson Lake, Stillwater Marsh is still an important area for white-faced ibis.
Strategies to Achieve Objective: Suitable nesting habitat would be maintained as prescribed under the white-faced ibis and redhead production objectives. Carp control and water manipulation would be undertaken in part to enhance productivity of invertebrates. When sufficient water is available, grassy shorelines and pastures would be flooded to provide additional shallow wetland feeding areas. Irrigation turnouts in East and Paiute Pastures would be repaired to facilitate water spreading.
Monitoring Elements: Annual use-days and population peaks of white-faced ibis.

Objective B.5: Provide feeding areas for white pelicans nesting on Anaho Island and those migrating through the Lahontan Valley to sustain an annual of 236,000 white pelican use-days over average over a five-year period.

Basis of Objective: Stillwater NWR/WMA and Fallon NWR is the main feeding area for white pelicans nesting on Anaho Island NWR.
Strategies to Achieve Objective: The overall strategy to preserve and manage wetlands to meet the goals for overwater nesting birds will contribute, but only partially, to meeting the pelican maintenance objective. Conversely, water and fishery management actions designed specifically to benefit pelicans will, in most instances, conflict with reaching higher priority objectives for redheads and ibis. To enhance foraging opportunities for white pelicans, without hampering achievement of other objectives, several strategies could be employed. Holding water at high levels during spring would be avoided to the extent possible. Wetland units that historically produce few ducks could be lowered or held below operational levels until June, and could be managed to encourage and sustain forage fish. During spring, moving water attracts carp where they concentrate in canals; excess water could be used to maintain spring flows for this purpose. Flooding abandoned units, especially those that are vegetated, would trigger fish spawning, and if sufficient water is available, these units could be maintained for an additional year.
Monitoring Elements: Annual use days of white pelicans.

Objective B.6: Provide a variety of habitats capable of supporting, over a five-year period, an annual average of 2,600,000 shore/marsh/waterbird use-days.

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Basis of Objective: Stillwater NWR, Stillwater WMA and Fallon NWR wetlands have traditionally attracted a variety of wetland-dependent bird species.

Strategies to Achieve Objective: In most cases, the use of water specifically to manage for species using mudflats would be at cross purposes to meeting objectives for over-water nesters and could increase the potential for botulism outbreaks. However, water could be used to achieve this objective to the extent that the water is not needed to meet the needs of other species. For example, when flushing saline water as a management effort to promote the retention or establishment of emergent nesting vegetation, as much water as possible should be run through dry impoundments and used in alkali flats. When water is especially abundant, additional impoundments and alkali flats can be shallowly flooded.

Monitoring Elements: Combined annual use days of shorebird and other waterbirds.

Goal C: Preserve, manage, and protect a variety of wetland habitats and resulting wildlife diversity.

Objective C.1: Provide protection, habitat, and a food source of waterfowl sufficient to maintain, over a five-year period, an annual average of 1,100 bald eagle and peregrine falcon use-days.

Basis of Objective: Bald eagles and peregrine falcons, at the time this objectives was developed, were a federally-listed endangered species.

Strategies to Achieve Objective: Meeting management objectives for wintering waterfowl and other prey species is essential, but will not ensure high bald eagle populations. Other specific actions are needed. Objectives for waterfowl and other waterbirds will be sufficient to increase peregrine falcon use of the area.

To the extent possible, water would continue to be moved through wetland units to maintain open water to sustain a wintering population of waterfowl during December-March, which is the main period of use by bald eagles but the period of lowest waterfowl numbers. Mature cottonwood trees are important for daytime perches and night roosting, and because few are present in the area, a tree nursery of 100 cottonwoods would be maintained. About 20 to 30 trees with a height of 10 to 20 feet would be planted annually in February or March in selected sites away from areas of public use. The 1987 plan calls for young cottonwood trees to be protected from livestock grazing, especially at Timber Lake and wetlands in the Carson River delta (important winter roost sites of bald eagles), but this has not occurred as yet.

Monitoring Elements: Annual use days and peak populations of bald eagles.

Objective C.2: Maintain or create habitat diversity, within the constraints of other objectives, to achieve maximum wildlife diversity, and increase production and maintenance of key sensitive species that use the area.

Basis of Objective: This alternative was developed under the assumption that, although Stillwater NWR's high altitude, alkaline, semi-desert uplands severely limits its habitat

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diversity, a few individuals of each species uncommon to the area can be maintained and populations of rare species increased. The intent of this objective would be to retain as much diverse habitat as possible by creating temporary or permanent ecosystem "niches." Under this alternative, the number of vertebrate species using an area is a measure of its diversity.

Strategies to Achieve Objective: To meet wildlife diversity objectives in marsh habitats during the breeding season, the strategies for meeting higher priority objectives discussed above should ensure the retention of most species. Other management actions would include the following. Livestock grazing would continue to be adjusted to improve range condition, plant vigor, increase the amount of residual plant material, and to increase the survival of cottonwood seedlings. Saltcedar control efforts would focus on reducing public hazards, such as blind corners on refuge roads, and to facilitating water movement in refuge delivery canals. Law enforcement efforts would be increased to reduce the extent of wood cutting, in order to protect litter habitat, snags, and fallen trees.

Limited use of herbicides has been used to control saltcedaron Stillwater NWR. In recent efforts, saltcedar concentrations were located, cut down with either a chainsaw or brush cutter, and then the cut stumps were treated with a 50 percent solution of Rodeo. So far, this technique has been used only on canals and has not been used on any large concentrations of saltcedar.

Monitoring Elements: Number of vertebrate wildlife species using the area (e.g., vertebrate species richness).

3.4.A.2.2.2 Public Use Management

Guiding Principles

The management of public use on Stillwater NWR, under this alternative, would be guided by the following principles. Hunting would continue to be the priority public use on Stillwater and Fallon NWRs, and Stillwater WMA, with few restrictions imposed. Public use programs would be developed beyond basic monitoring procedures as staff time allows. Traditional uses, such as birdwatching, camping, horseback riding, and hiking would be continued in all portions of the refuges and WMA with few restrictions. Environmental education and interpretive efforts would be conducted by appointment only, or would be self guided.

No additional facilities would be developed and the refuge would remain in a fairly primitive state.

Objectives and Strategies

Goal D: Improve the quality of existing wildlife/wildland recreation and enhance opportunities for interpretation and environmental education.

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Objective D.1: Maintain at least 5,400 hunter use-days by waterfowl hunters, with improvements in quality, opportunity, and compliance aspects.

Basis of Objective: Hunting was one of the purposes for which Stillwater WMA was originally established. Targeting 5,400 hunter use-days/year would ensure that the hunt program remains a viable, vigorous program on Stillwater NWR, as per the 1987 Management Plan. At the time the plan was written, regulatory compliance, especially on opening day, was considered low. This objectives was written to support the Region 1 Program Management Brief Objective for providing a quality hunt program.

Strategies to Achieve Objective: An important part of meeting this objective would be to achieve the objectives for associated wildlife species.

The current boundaries and zones between hunting and nonhunting areas would be maintained in this alternative. Up to 70 percent of fall and winter wetland-habitat would be open to hunting during the hunting season (Map 3.2).

The number of hunters would not be limited, and the area would be open to hunting every day during the hunting season. Restricting hunters to permanent, space blinds and shot-shell limits would not be required.

Numerous access roads, dike roads, and boat ramps make the entire open area readily accessible. Parking and camping would continue to be permitted anywhere along open roads as long as roads and boat ramps are not blocked and cross-country vehicle travel is not employed. All areas open to hunting would allow watercraft including airboats, with few restrictions. However, at least one wetland unit would be closed to airboat use. No new launch ramps would be installed and existing ramps would not be improved.

The retrieval zone along the Division Road would be maintained, and the use of leaflets, posting, including the use of swan silhouettes would be employed to educate hunters about regulations and waterfowl identification. The Service would conduct waterfowl identification workshops to reduce the potential to overbag canvasbacks and redheads, taking of trumpeter swans, and the taking of tundra swans without a permit. A high level of coordination regarding patrolling and enforcement would be maintained.

Hunting of waterfowl, mourning doves, California quail, turkey, and mule deer would continue to be allowed on federally-owned land along the Carson River and D-Line Canal, and in the Indian Lakes area. Hunting throughout the remainder of Stillwater WMA would also be permitted, with the primary target species being coyotes and jackrabbits.

Monitoring Elements: Annual hunter use-days.

Objective D.2: Encourage educators to use Stillwater NWR and Stillwater WMA to conduct environmental education field studies that focus on wetland ecosystems and adjacent uplands, with a target of 100 visits and 400 activity hours annually within a five-year period.

Objective D.2.1: Attain and sustain at least 75 visits per year by outdoor classes for students.

Basis of Objective: This objective was developed to support I & R Program Management goals and the Region 1 Program Management Brief Objective to assist teachers engaged in outdoor classroom activities. Environmental education is an important vehicle to increase the public's understanding wildlife and their habitat needs, and to enhance awareness of what this area has to offer and what the Service and Refuge System missions are.

Strategies to Achieve Objective: The environmental education program would be designed so that it can be taken to schools and agency offices as staff time permits. Traveling audio/visual programs would be designed so that any available refuge employee could give a slide show or school talk. Programs would continue to be upgraded and used prior to field tours. Lesson plans to be developed would focus on local environmental issues. Off-site programs would include environmental education programs coordinated with other Federal, State, and local agencies, educational institutions, conservation organizations and private landowners and their representative organizations.

Monitoring Elements: Annual visits by outdoor classes.

Objective D.3.1: Attain and sustain at least 25 visits per year by outdoor classes for teachers.

Basis of Objective: Same as above. Also, achieving this objective would encourage teacher-led field trips rather using refuge staff time, which could alleviate the need to turn away school groups when no staff member is available.

Strategies to Achieve Objective: Teacher workshops would be held to refine plans developed under Objective D.3.1, to introduce curricula to other teachers, and to generate awareness. Liaison work with educational groups would continue.

Monitoring Elements: Number of workshops given per year.

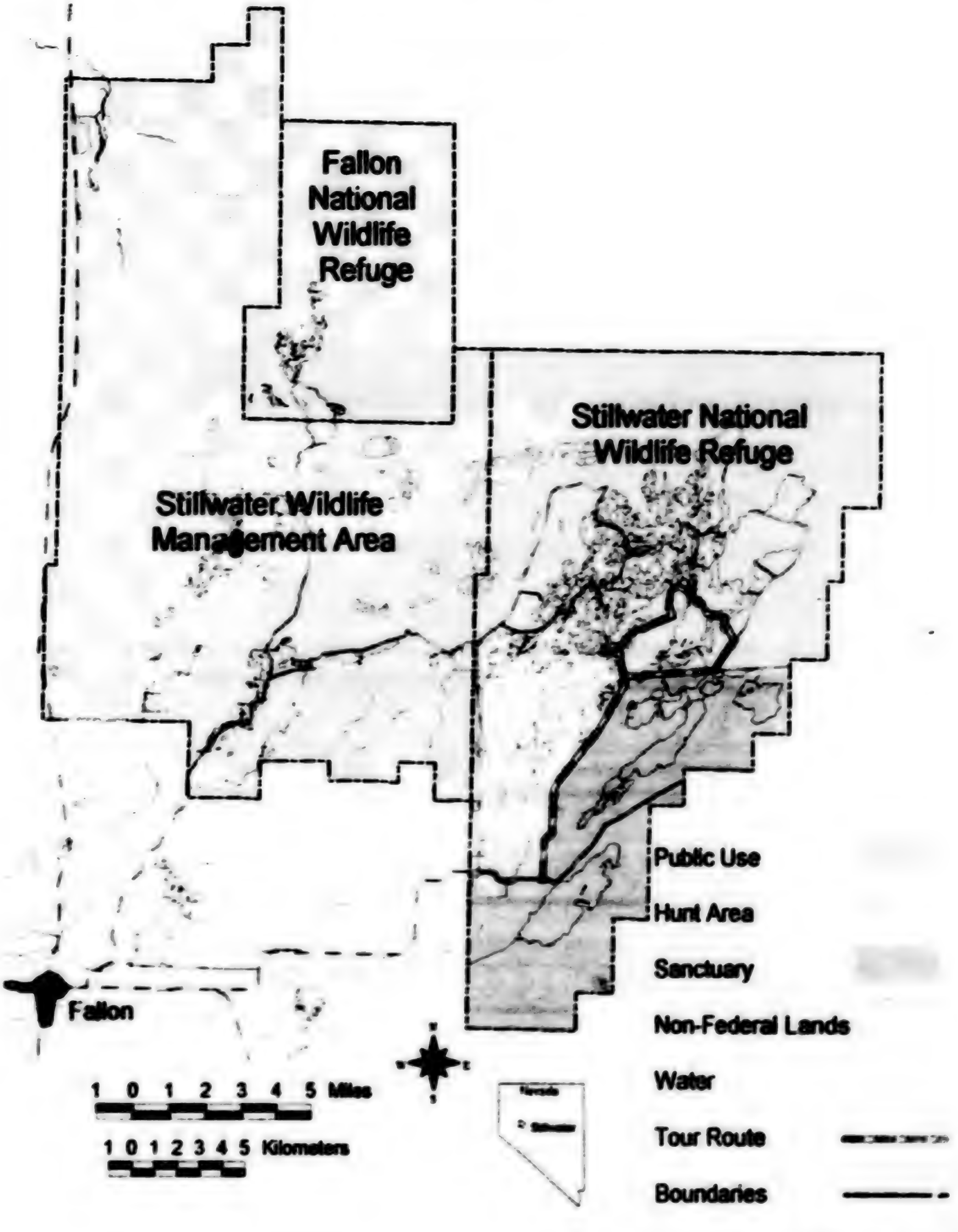
Objective D.4: Provide guided interpretive tours for students and members of interested organizations to develop an awareness of habitats, wildlife, management, basic ecological principles, and resource problems, with a target of sustaining at least 1,410 hours of interpretive tours each year.

Basis of Objective: Achieving this objective would contribute toward increased public awareness of wildlife resources, conservation issues, and activities of wildlife agencies. As pointed out in the 1987 plan, many local people are not aware of the wetlands and for those that are, few realize who manages them, or what is involved in their management.

Strategies to Achieve Objective: As staff time permits, guided tours of the refuge would be provided for groups to develop an awareness of habitats, wildlife, management, and basic ecological principles and resource problems. No additional facilities would be constructed. Supplies of brochures, wildlife lists, handouts, and briefing material would be maintained, and roads would maintained as needed.

Monitoring Elements: Hours of interpretive tours.

Map 3.2 Stillwater Public Use Zones
Alternative A



GIS Analysis by
U.S. Fish and Wildlife Service

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Objective D.5: Provide opportunities for visitors to view, appreciate, and enjoy wildlife in "natural" settings during all seasons of the year, with a target of attaining and sustaining at least 4,200 visits by wildlife/wildlands observers.

Basis of Objective: Stillwater Marsh, set against the Stillwater Range, although highly developed, presents a natural appearing scenic vista to the public for improving the quality of visits and visitor's understanding and awareness of wildlife resources and conservation issues, including problems facing wildlife and wildlands.

Strategies to Achieve Objective: The existing auto tour route would be maintained, and directional signs marking the route would be replaced when needed. Roads would be maintained for safe travel in fair weather conditions, and signs would be replaced and maintained as per the 1982 Stillwater Wildlife Management Area Sign Plan. The main route would begin at Stillwater Point and proceed to Hunter Road, to Nutgrass Road, to Navy Cabin Road and back to Hunter Road and Stillwater Point (Map 3.2).

Sufficient publications would be maintained to inform visitors of wildlife, rules and regulations, and tour routes. These publications would be available at the Refuge office, and would be disseminated from specially-designed containers at strategic locations on the refuge, and eventually through the Internet. The media would be used to encourage visits to the refuge during the non-hunting season, especially when roads are dry and migrant waterbirds are present.

Wildlife photography would be encouraged, but no special facilities would be provided.

Monitoring Elements: Number of visits per year.

Objective D.6: Manage and maintain a quality public fishing program, as long as it is compatible with other objectives, with a target of attaining and sustaining 9,200 visits by anglers.

Basis of Objective: Although fishing was not mentioned as a purpose or objective in the 1948 Tripartite Agreement, fishing was a popular activity in the area now encompassed by Stillwater NWR and Stillwater WMA.

Strategies to Achieve Objective: Fishing would be allowed, but not be prohibited. Facilities for fishing would not be provided. Stocking would not be permitted in Stillwater NWR. Fish resources would be maintained through strategies to meet other, higher priority objectives. Due to the high level of mercury contaminants in the Lahontan Valley, an advisory was issued by the State of Nevada noting that it is not save to eat any fish caught in the Lahontan Valley.

Monitoring Elements: Number of visits by anglers per year.

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3.4.A.3 Anaho Island NWR

3.4.A.3.1 Management Program

3.4.A.3.1.1 Fish, Wildlife, and Vegetation Conservation

Additional information is provided on the management of Anaho Island NWR than what was written in the 1987 plan for the Stillwater WMA. This discussion presents how the refuge has been managed in recent years.

Guiding Principles

Under this alternative, Anaho Island NWR would be managed as a bird sanctuary closed to public use to prevent human intrusion and disturbance at one of Nevada's most important breeding sites for colonial nesting birds such as American white pelicans, double-crested cormorants, California gulls, Caspian terns, and great blue herons. Wildlife conservation at Anaho Island NWR would consist of providing a secure breeding habitat for colonial nesting birds, custodial maintenance of the land, and routine monitoring of bird populations. Because Anaho Island has been proposed for wilderness designation as a roadless island (Section 3.2.2.1.6), it will be managed to preserve its wilderness character, which is consistent with its current management.

Objectives and Strategies

Anaho Island NWR is managed primarily as a sanctuary for colonial-nesting species, mainly white pelicans. The following objectives and strategies were developed to reflect past management of the refuge. Few details were provided in the 1987 plan.

Goal A: Protect and perpetuate colonial-nesting birds and other migratory birds.

Objective A.1: Provide a sufficient amount of nesting habitat, free from human disturbance and other threats, for colonial-nesting birds during the breeding season.

Basis of Objective: The nesting colony of American white pelicans, which can reach about 10,000 breeding pairs, is one of the largest colonies in the United States, and is important to other colonial nesting birds as well. Colonial nesting birds are sensitive to disturbance during nesting and while chicks are young. Eggs and chicks are left exposed to predation and weather when adults leave the nest due to disturbance. This objective is critical to the accomplishment of the goal.
Strategies to Achieve Objective: The island would remain closed to public access and use, and the Pyramid Lake Paiute Tribe would continue to provide law enforcement in coordination with the Service. Signs would be posted on the island, as well as 500-feet off shore, notifying the public that the island is a closed area.

An outreach program would be implemented to increase public understanding of the need to for the closure, emphasizing the importance of Anaho Island to white pelicans and other birds and the detrimental effects of disturbance. This would include maintaining existing interpretive panels, and could also include providing new panels at the Sutcliff marina boat ramps and boat ramps on the eastern shore of the lake near Pyramid Island. Voluntary compliance of the closure is essential.

Monitoring Elements: Acreage of available nesting habitat of suitable quality, level of compliance/noncompliance with the closure, and response by birds (e.g., number of breeding pairs, number of chicks per nest, nest success, number of nest failures or dead nestlings).

Objective A.2: Prevent the formation of a land bridge between the eastern shore of Pyramid Lake and Anaho Island.

Basis of Objective: Formation of a land bridge would introduce mammalian predators to the island, which would have significant adverse impacts to colonial-nesting birds.

Strategies to Achieve Objective: The water-surface elevation of Pyramid Lake would be monitored to ensure that lake levels are high enough to avoid a land bridge forming from the eastern shore of the lake to the island. Given other efforts that would increase flows in the lower Truckee River, the formation of a land bridge is not anticipated to happen.

Monitoring Elements: Pyramid Lake water-level elevation.

Objective A.3: Closely monitor the breeding population of each colonial-nesting species (white pelicans, double-crested cormorants, gulls, herons, and egrets) to track the number of nesting pairs, nestlings, and fledglings each year.

Basis of Objective: Refuge Managers can only determine whether the goal is being attained by obtaining estimates of the breeding population and juveniles successfully reared.

Strategies to Achieve Objective: Monitoring of pelicans and other colonial-nesting birds would continue much as it has in the past. At least one count would be conducted each month from April through July, to attain counts of the number of nesting pairs, number of chicks per nest, and the number of fledglings. Additional details would be provided in the refuge's monitoring plan.

Monitoring Elements: Number and type of count by period.

Objective A.4: Promote research opportunities that would increase the Service's understanding of colonial-nesting bird life history requirements and potential limiting factors.

Basis of Objective: Research conducted by organizations outside the Service is often needed to obtain specific information on colonial-nesting bird species life history requirements and factors limiting breeding success, such as food availability and contaminant levels.

Strategies to Achieve Objective: Identify research needs and coordinate with interested universities to establish research projects. All projects would be designed to avoid disturbing breeding birds and their nests, nestlings, and fledglings.
Monitoring Elements: Reports of research results.

3.4.A.3.1.2 Public-Use Management

Guiding Principles

Anaho Island NWR is closed to public use in order to protect colonial-nesting birds. Distribution of information about Anaho Island NWR, however, could educate the public on the need for and benefits of national wildlife refuges, including those which cannot be directly used by the public. The benefits of Anaho Island NWR go far beyond the shore of the island, as white pelicans and other colonial-nesting birds reared on the refuge disperse throughout the western United States.

Objectives and Strategies

No objectives would be developed for public use associated with Anaho Island NWR.

3.4.A.4 Other Program Areas

3.4.A.4.1 Commercial Use Program

Guiding Principles

Livestock grazing and muskrat trapping would be managed commensurate with wildlife conservation, as outlined in the 1948 Tripartite Agreement.

Strategies

Under this alternative, livestock grazing by existing permittees would continue, up to a maximum use level of 11,000 AUMs on Stillwater NWR, Stillwater WMA, and Fallon NWR. Muskrat trapping would continue as currently managed, with opportunities for up to 40,000 animals to be trapped each year, primarily in Stillwater Marsh.

Livestock grazing would continue at present levels on Stillwater WMA, but would be reduced on Stillwater NWR. Livestock would continue to graze lake shore, riparian, meadow, marsh, salt desert shrub, and dune habitats in the Stillwater WMA and Fallon NWR. Internal fences would not be constructed, continuing the communal livestock grazing program. Special-use permits

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would continue to be provided on a bid system. Providing opportunities for muskrat trapping would be based on availability of the resource.

European carp and Sacramento blackfish have periodically been harvested from several lakes in the Indian Lakes area, including Likes Lake, Papoose Lake, and Big Indian Lake. The emphasis of the commercial fishing program is to control carp and blackfish populations. Prior to the drought in the late 1980s and early 1990s, several hundred to several thousand pounds were removed about every one to three years under a special use permit. This would continue as needed.

3.4.A.4.2 Outreach Program

Guiding Principles

A principle that would guide outreach efforts is that public awareness of the Service and the Service's mission and role in wildlife conservation is needed for the effective management of the Refuge System as a whole. The American people cannot appreciate or support what they do not know exists or do not understand. To improve refuge management, the Service must build a strong base of public understanding and support, reaching beyond the public that visit refuges. Outreach is a two-way communication between the Service and the public to establish mutual understanding and promote involvement with the goal of improving joint stewardship of our natural resources.

Strategies

Outreach efforts would continue under this alternative. Outreach methods would include continued interactions and relations with congressional entities, local businesses, news media, constituent groups, local community, schools, state and local governments and agencies, as well as public involvement in planning processes and information products such as brochures, leaflets, videos (USFWS 1997). These methods would provide ways for the public to be involved with Stillwater NWR Complex during the planning processes and beyond.

Under this alternative, refuge staff would continue to conduct outreach through interactions with the public. Proactive efforts would include involving the public in planning processes, and the Service would participate in special events and programs, public meetings, presentations and speeches, and cooperative outreach partnerships.

Presentations at schools and civic organizations would be conducted by appointment depending on staff schedules and funding. Refuge staff would coordinate with the other Service offices regarding conducting school programs. Some of the special events in which the Service would continue to participate include Refuge Week celebrations and the Spring Wings Bird Festival.

3.4.A.4.3 Other Public Uses

Guiding Principles

Other public uses, those that are not identified in public-use objectives and are not identified as a commercial use (above), would be allowed but not promoted.

Strategies

Few restrictions would be imposed on other public uses and opportunities for the following uses would continue much as they have in the past: boating would continue in open wetland units and in the Indian Lakes area; horseback riding would continue with few restrictions; hiking would continue to be permitted throughout the open area but no trails would be developed or maintained; camping would allowed throughout the year in open areas of Stillwater NWR and Stillwater WMA. Off-road vehicle use would not be permitted.

3.4.A.4.4 Partnerships and Other Cooperative Efforts

Guiding Principles

A guiding principle under this alternative is the recognition that conservation organizations, including hunting groups, have contributed significantly toward the conservation of fish, wildlife, plants, and their habitats. Conservation partnerships with other Federal agencies, State agencies, Tribes, organizations, industry, and the general public can make significant contributions to the conservation of biological resources on Stillwater, Fallon, and Anaho Island NWRs, as well as helping the Service to provide opportunities for compatible wildlife-dependent recreational uses. Cooperative efforts with other land owners are essential when addressing those problems, such as the encroachment of saltcedar, that extend, or originate, beyond the boundaries of the refuge. However, conservation partnerships and cooperative efforts are not limited to accomplishing refuge purposes. They can also help achieve goals for wildlife conservation and environmental education outside refuge boundaries.

Strategies

Existing partnerships would continue. The Service would cooperate with other agencies, institutions of higher education, private organizations and individuals. For example, members of the Fallon Paiute-Shoshone Tribe would be allowed periodic access to designated areas, for the purpose of conducting religious ceremonies or to teach their traditional ways.

3.4.A.4.5 Water-Rights Acquisition and Land Disposal Program

The ongoing water-rights acquisition program for Lahontan Valley wetlands is summarized in Sections 3.2.1.3.5 and 3.3.1.1, and described under Alterantive 5 of the WRAP EIS and in the

Record of Decision for the WRAP (USFWS 1996a,b). The land disposal program that is being developed, as part of the water-rights acquisition program, is addressed in Section 3.3.1.1.

3.4.A.4.6 Fire Management

Guiding Principles

Upon approval of a fire management plan, the focus and major commitment of the fire management program would be to ensure the safety of firefighters and the public. Human life, property, and other resources would be protected from unplanned fires. Fires would also be used as appropriate to accomplish resource management objectives and to accomplish refuge maintenance objectives. Parallel to wildlife and habitat objectives, the emphasis would be on enhancing waterfowl habitat.

Objectives and Strategies

As outlined in the draft Fire Management Plan (Appendix K), goals of the fire management program would be as follows.

1. Firefighter and public safety is the priority goal of the program. All fire management activities will reflect this commitment.

2. Protect life, property, and other resources from wildfire.

3. Use fire as a tool, where appropriate, to accomplish resource management objectives.

4. Use fire as a tool, where appropriate, to accomplish refuge maintenance objectives.

Objectives of the fire management program would be as follows.

1. Protect all important scientific, cultural, historic, prehistoric, and administrative sites, visitor facilities, and refuge housing from fire.

2. Restore and perpetuate habitats important to migratory and other native wildlife species, by maintaining a diversity of plant communities in various stages of succession.

3. Use fire as a tool to limit the spread and/or facilitate the elimination of noxious weeds.

4. Use fire to facilitate and augment the farm and water management programs..

5. Prevent human-caused wildfires.

Strategies can be found in the selected sections of the Fire Management Plan provided in Appendix K.

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3.4.A.4.7 Cultural Resource Management

Guiding Principles

Stillwater NWR and the surrounding Lahontan Valley have a strong tradition of archaeological and ethnographic research, and the local Fallon Paiute-Shoshone Tribe has maintained a vital interest in its traditional culture and archaeology. To the extent that funding permits, research would continue. However, the management of cultural resources on Stillwater NWR, under this alternative would be guided by the basic compliance requirements of the cultural resource legislation and agreements described earlier in Section 1 of this chapter. In practice, this means that emphasis would continue with, and be mostly limited to, Section 106 of the National Historic Preservation Act. The Service will continue to carry out the provisions of the 1988 MOU on Human Remains from Stillwater NWR among the Service, the Fallon Paiute-Shoshone Tribe, and the Nevada State Historic Preservation Office. The MOU set forth procedures for the identification, protection, reburial, collection, curation, study, reinterment, and consultation on human remains at Stillwater NWR. Cultural resource management would remain a basic component of land management at Stillwater NWR.

With respect to Anaho Island NWR, reconnaissance surveys at Anaho Island NWR have not identified any significant prehistoric cultural resources (archaeological sites). However, Anaho Island figures prominently in the spiritual beliefs of the Pyramid Lake Paiute Tribe. Given the limited access to the island by visitors (it is closed to public access) and the largely passive management of the land and its wildlife, cultural resource management is not a significant issue at Anaho Island NWR.

Strategies

Cultural resource management would remain a basic component of land management at Stillwater NWR as described under the Guiding Principals above and the legislation and agreements described in Section 1. In consultation with the Fallon Paiute-Shoshone Tribe, the Service would continue to manage cultural resources so that they are preserved. Stillwater NWR and the surrounding Lahontan Valley have a strong tradition of archaeological and ethnographic research. To the extent that funding and staff become available, these efforts would continue on Stillwater NWR. The local Fallon Paiute-Shoshone Tribe has maintained a vital interest in its traditional culture and archaeology.

3.4.A.4.8 Monitoring and Research Program

Guiding Principles

Monitoring would continue to focus on wildlife populations, primarily waterfowl and white pelicans, but with a growing emphasis on other birds including shorebirds, other waterbirds, bald eagles, and mourning doves. Habitat monitoring would continue to focus on overall wetland-habitat acreage and aquatic submergent vegetation.

Strategies

Under Alternative A, monitoring of wildlife, habitat, public use, and other uses would proceed as it has for the past several years. Wildlife and habitat monitoring is summarized in Table 3.2.

Habitat monitoring would continue to primarily involve the amount and distribution of wetland-habitat (an annual aerial survey in August), aquatic vegetation surveys (August), water quality (variable), pan evaporation (monthly), and limited monitoring of livestock grazing effects on vegetation (two exclosures, spring and late summer). Acreage of wetland-habitat on Stillwater NWR, Stillwater WMA, and Fallon NWR would also continue to be roughly estimated on a monthly basis, and wetland water flows would continue to be observed on a weekly basis.

Wildlife monitoring would continue to focus on waterfowl (Stillwater NWR) and white pelicans (Anaho Island NWR), but would also include shorebirds, other waterbirds, bald eagles, other raptors, and mourning doves. Ongoing waterfowl surveys would include aerial surveys during the hunting season and breeding season, brood surveys, goose collar observations, and swan age ratios.

Public use monitoring would continue to rely on road counters along Hunter Road, Indian Lakes Road, Division Road, and West County Road. Visitation is assessed by assuming that 10 percent of use is staff and local travel. Because a vehicle could be counted twice, once when entering and again when exiting, the numbers are divided by two. Other assumptions such as hunting and wildlife observation pressures are assessed based on time of year. A visitor log would be maintained, but because it is located at the refuge complex headquarters in Fallon it is not an accurate record. A check-station on opening weekend of the waterfowl-hunting season would be continued in coordination with the Nevada Division of Wildlife, and information obtained from this ongoing effort would be used. Staff would track the number of visitors attending tours, special events, and environmental education programs.

3.4.A.4.9 Facilities Maintenance and Safety

Guiding Principles

Facilities, including roads, structures, grounds, and equipment on the Stillwater NWR Complex would be maintained in a clean and orderly appearance, in an energy-efficient condition, and in such condition that protects the health, safety, and convenience of refuge staff and the general public. Facilities and equipment determined to be no longer needed or safe, or too expensive to maintain, would be surveyed and eliminated.

Table 3.2. List of ongoing biological surveys conducted on Stillwater NWR, and a summary of the frequency of each survey, the agency conducting the surveys[A], and the location of data.

Survey	Schedule	Surveyor	Data Storage
Habitat			
Aerial survey of wetland acreage[B]	Annual (Aug.)	NDOW/Refuge	Refuge
Aquatic vegetation surveys	Annual (Aug.)	Refuge	Refuge
Pan evaporation[B]	Annual (monthly)	Refuge	Refuge
Livestock exclosure monitoring	Annual (spring/summer)	Refuge	Refuge
Waterfowl			
Aerial surveys[B,D]	Annual (Oct-Dec.)	NDOW	NDOW
Aerial breeding pairs surveys[B,D]	Annual (March/May)	NDOW	NDOW
Broods surveys[B]	Annual (June/July)	NDOW/Refuge	NDOW/Refuge
Trapping/banding	As Requested	NDOW/Refuge	NDOW/Refuge
Goose collar observations[C]	Annual (Nov.-Feb.)	NDOW/Refuge	NDOW/Refuge
Swan age ratios[B]	Annual (Nov.-Feb.)	NDOW/Refuge	NDOW/Refuge
Colonial Birds			
Ground survey of Anaho Island	Annual (Apr.-Aug.)	Refuge	Refuge
Aerial survey[C]	Annual (May/June)	NDOW	NDOW
Shorebird			
Fall and spring shorebird surveys[B]	Annual(April/Aug.)	NDOW/Refuge	NDOW/Refuge
Snowy plover nesting surveys[C]	Annual(May-June)	NDOW/Refuge	NDOW/Refuge
Raptors			
Bald eagle roost counts[B]	Annual (Nov.-Feb.)	NDOW/Refuge	Refuge
Raptor routes	Annual (Nov.-Feb.)	NDOW/Refuge	Refuge
Breeding Bird			
Mourning dove call counts[C]	Annual(May)	NDOW/Refuge	NDOW
Wildlife Disease			
Botulism patrols/pickup[C]	Annual(June-Oct.)	NDOW/Refuge	NDOW/Refuge
Contaminant Surveys			
Level I surveys[B]	As Requested	Refuge	Refuge
Assessment of biological samples[B]	Annual(May-Oct.)	Refuge/ES	Refuge/ES

[A] Refuge = Stillwater NWR Complex (Service) staff; NDOW = Nevada Division of Wildlife staff; and ES = Ecological Services (Service) staff.

[B] Conducted as part of a Lahontan Valley-wide effort.

[C] Conducted as part of a Western Nevada-wide effort.

[D] Conducted as part of a State-wide effort.

Strategies

Facility maintenance would continue much as it has in the past, with activities being undertaken as needs arise. Muskrats may be controlled along dikes to reduce damage to dikes. Beavers would be removed, through trapping and other means, from water delivery canals and riverine-riparian areas of the refuge. The current assumption is that beavers are not native to the Lahontan Valley; but this assumption would be investigated further.

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3.4.A.4.10 Law Enforcement

Guiding Principles

The dominant principle under this heading is that the Service would enforce all laws and regulations under its jurisdiction. Although the refuge's law enforcement program would primarily be limited to the refuge, it goes well beyond enforcing the laws, regulations, and refuge policies that pertain to the achievement of refuge purposes and goals. The refuge law enforcement program also includes, the enforcement of State hunting, fishing, and boating regulations; safety regulations; and cultural resource laws.

Strategies

The refuge law enforcement program would continue to be carried out by collateral-duty refuge officers, Nevada State game wardens, and, through a MOU, Bureau of Land Management rangers. Assistance to other Federal and state law enforcement agencies would be provided on certain off-refuge operations; particularly in relation to the Migratory Bird Treaty Act and the Archaeological Resources Protection Act violations. The use of posting and leaflets would be continued.

3.4.A.4.11 Budget and Administration

Guiding Principles

Every effort would be made to maintain a sufficient level of staffing and funding to effectively and efficiently accomplish the purposes of the refuges and the wildlife management area in the complex. Stillwater NWR Complex administration includes the management of staff, budget, and other resources to accomplish refuge goals and other programs.

Strategies

The projected annual costs of managing the Stillwater NWR Complex under Alternative B would be an estimated $3.1 to 3.4 million/year upon completion of the water-rights acquisition program. Projected annual expenditures include salaries; refuge operation and maintenance costs; water delivery and operation and maintenance charges; refuge revenue sharing payments; and water-rights leasing costs. Annual expenditures related to the water-rights acquisition program were discussed in Section 3.3.1.1., Features and Assumptions Common to all Alternatives. Refuge salaries and operations and maintenance costs would be an estimated $1.36 million/year under this alternative. Total capital costs of the water-rigths acquisition program are presented in the WRAP EIS (USFWS 1996a).

Current refuge staff includes thirteen permanent full-time positions, one term position, two temporary positions, and two seasonal positions, as shown below. Government staffing is usually expressed in units of "full-time equivalents" (FTE). One permanent, full time position represents one FTE. One seasonal position working six months out of the year represents 0.5 FTE. Term and temporary positions are generally 1 FTE.

Staffing required to implement Alternative A is presented below:

Stillwater NWR Complex Staff

Project Leader	GS-13
Deputy Project Leader	GS-12
Refuge Manager	GS-11
Refuge Manager Trainee	GS-5/7/9
Administrative Support Assistant	GS-7
Office Automation Clerk	GS-5
Wildlife Biologist	GS-11
Wildlife Biologist	GS-9/11
Wildlife Biologist (temporary)	GS-5
Geographic Information Specialist (term)	GS-11
Outdoor Recreation Planner	GS-7/9/11
Supervisory Engineering Equipment Operator	WS-8
Engineering Equipment Operator	WG-9
Heavy Equipment Mechanic	WG-10
Maintenance Worker	WG-8
Engineering Equipment Operator (temporary)	WG-8
Maintenance Worker (seasonal-vacant)	WG-8
Maintenance Worker (seasonal-vacant)	WG-8

On-site Realty Personnel (supervised and funded out of Regional Office)

Supervisory Realty Specialist	GS-13
Senior Appraiser	GS-12
Realty Specialist	GS-9

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3.4.B ALTERNATIVE B

As with Alternative A, this alternative would focus refuge management on providing for the needs of key wildlife species. Of particular emphasis under this alternative would be providing high-quality fall and winter habitat for waterfowl and waterfowl hunting. Due to low evaporation rates during the fall and winter, extensive wetland-habitat would remain available into the spring, which would benefit breeding waterfowl, shorebirds, and other marsh birds. Because this alternative focuses on management of waterfowl, shorebirds, and other marsh birds, only the lands and waters now within Stillwater NWR and Fallon NWR would remain in the Refuge System. This would encompass Stillwater Marsh and the Carson River delta wetlands. Fallon NWR would remain as a separate refuge unit.

Under this alternative, opportunities for wildlife-dependent recreation would be enhanced over existing conditions. Waterfowl hunting would remain an integral part of the program and waterfowl hunting opportunities would increase. The environmental education program would be enhanced to some degree and areas for wildlife observation and environmental interpretation would be developed in the marsh.

Anaho Island NWR would continue to be managed much as it has in the past, with an emphasis on protecting the nesting colony of American white pelicans and other colony-nesting birds that use the island. Monitoring would continue.

Some of the major headings under Alternative B are:

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Broad Management Direction 3-68

Stillwater NWR

    Boundary 3-70
    Wildlife and Habitat Management 3-73
    Public Use Management 3-93

Fallon NWR

    Boundary 3-98
    Wildlife and Habitat Management 3-99
    Public Use Management 3-105
Anaho Island NWR 3-108
Other Program Areas 3-108

3.4.B.1 Broad Management Direction

3.4.B.1.1 Refuge Purposes

Stillwater NWR (Public Law 101-618)

1. Restoring and maintaining natural biological diversity within the refuge.
2. Conserving and managing fish and wildlife and their habitat.
3. Fulfilling international treaty obligations of the United States with respect to fish and wildlife.
4. Providing opportunities for scientific research, environmental education, and fish and wildlife oriented recreation.

Fallon NWR (Executive Order 5606)

1. Providing a sanctuary and breeding ground for birds and other wildlife.

Anaho Island NWR (Executive Order 1819 and Public Law 101-618)

1. Benefitting and protecting colonial-nesting birds and other migratory birds.
2. Providing a preserve and breeding ground for native birds.

3.4.B.1.2 Refuge Goals and Other Programs

This section outlines the direction of management and the breadth of the management program to be carried out under this alternative. The wildlife and public use programs are the focus of management and, as such, are highlighted in refuge goals. Refuge goals, derived primarily from refuge purposes but also written to be consistent with the Refuge System Administration Act and other management authorities, broadly define how the lands and waters of the refuges would be managed under this alternative. The other programs listed after the goals provide support to achieve these goals and the overarching missions of the Refuge System and the Service, as well as ensure protection of other important resources, compliance with laws, safety, and administration of the complex.

Stillwater NWR Goals

A. Provide optimal feeding and resting habitat for waterfowl and other waterbirds, especially during fall migration and winter, and secondarily to provide optimal nesting, feeding, and resting habitat for these species during the breeding season.

B. Restore and maintain natural biological diversity.

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C. Provide opportunities for scientific research, environmental education, and wildlife-dependent recreation that are compatible with refuge purposes.

> ***Basis of Goals:*** These goals, which are listed in priority order, would maintain the traditional emphasis on waterfowl management, under the premise that providing for the needs of waterfowl and other waterbirds would provide for the needs of all other wildlife in the marsh. This approach focuses on the second purpose of the refuge, to conserve and manage fish, wildlife, and their habitat, and it generally supports the Refuge System mission. Goal B supports the first and third purposes of Stillwater NWR (restoration of natural biodiversity on and fulfillment of international treaty obligations, respectively), the Refuge System mission, and directives of the Refuge System Administration Act to maintain the biological integrity, diversity, and environmental health of the Refuge System. Goal C mirrors the fourth listed purpose of Stillwater NWR and supports directives of the Refuge System Administration Act which require the Service to facilitate compatible wildlife-dependent recreational uses in the Refuge System.

Fallon NWR Goals

A. Provide high-quality sanctuary and breeding habitat for migratory birds.

B. Restore and maintain natural biological diversity.

C. Provide opportunities for scientific research, environmental education, and wildlife-dependent recreation that are compatible with refuge purposes.

> ***Basis of Goals:*** Listed in priority order, these goals emphasize the purposes of the refuge (Goal A). Goal B supports the mission of the Refuge System and directives of the Refuge System Administration Act which require that Service to maintain the biological integrity, diversity, and that the environmental health of the Refuge System be maintained. Goal C supports directives of the Refuge System Administration Act which require the Service to facilitate compatible wildlife-dependent recreational uses in the Refuge System.

Anaho Island NWR Goal

A. Protect and perpetuate colonial-nesting birds and other migratory birds.

> ***Basis of Goal:*** This goal is directly based on the purposes for which Anaho Island NWR was established. It was originally established to provide a "...preserve and breeding ground for native birds," and this purpose was narrowed in Public Law 101-618 which clarifies that Anaho Island NWR is to be managed for "...the benefit and protection of colonial nesting species and other migratory birds." This goal supports the Refuge System mission.

Other Program Areas

In addition to refuge goals that generally outline how refuges are to be managed to achieve the purposes for which they were established, many refuges have other programs that are peripheral to the core programs (i.e., wildlife and wildlife-dependent recreation). Many of these, which are identified below and described in more detail later, are integrally related to the core programs.

- Outreach Program
- Partnerships and Other Cooperative Efforts
- Water-Rights Acquisition and Land Disposal Program
- Fire Management
- Other Public Uses
- Cultural Resource Management
- Monitoring and Research Program
- Facilities Maintenance and Safety
- Law Enforcement
- Budget and Administration

3.4.B.2 Stillwater NWR

3.4.B.2.1 Boundaries

Boundary Alternative B would result in no changes to the existing boundary of Stillwater NWR (Map 3.3). The ecological zones depicted in Map 3.3 show the general types of habitats that would be encompassed within this boundary alternative, as compared to their extent inside the existing boundaries. Ecological zones represented within Stillwater NWR would primarily include Stillwater Marsh, farmland, and one part of the dune system.

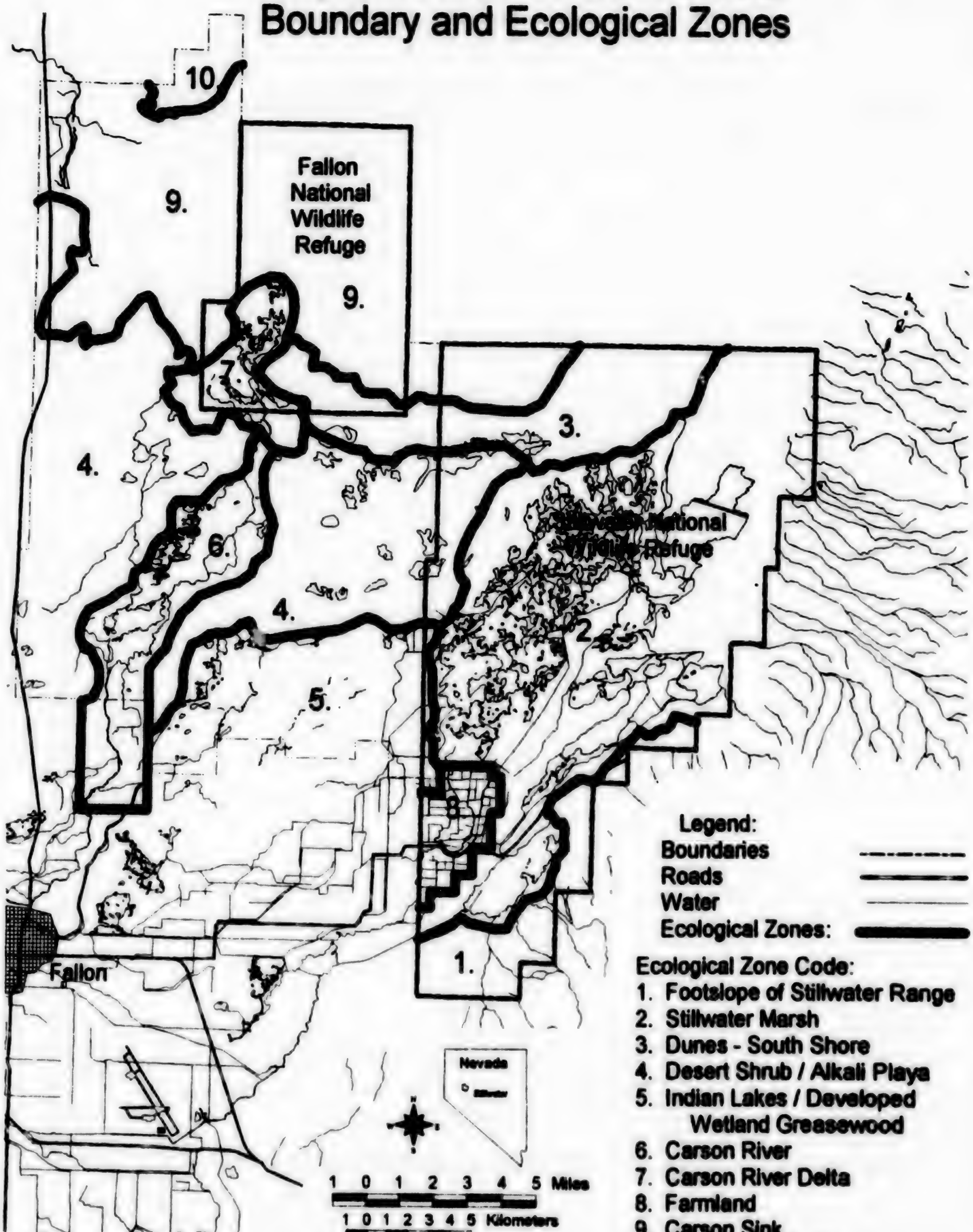
3.4.B.2.2 Management Program

If Alternative B were selected for implementation, information in this section would become the main contents of the comprehensive conservation plan for Stillwater NWR, although some of the detailed objectives and strategies may be pulled into a habitat management plan or public-use plan. These step-down plans would then be appended to the final comprehensive conservation plan.

The overall mission of Stillwater NWR, under this alternative, would be to provide high-quality fall and winter habitat for waterfowl and other wetland birds and for wildlife-dependent recreation during this period. Because of low evaporation rates during the winter and early spring, breeding habitat would also be provided to waterfowl, shorebirds, and other wetland wildlife. Hunting would continue to be highlighted, but opportunities for environmental education and interpretation, and wildlife observation and photography would be enhanced to the extent that they do not adversely impact the hunting program.

This section is divided into two main parts: (1) Native Fish, Wildlife, and Vegetation Conservation; and (2) Public Use Management. For each of these parts, guiding principles, the refuge goals (identified earlier), subgoals, objectives, and strategies are outlined. A summary outline of goals, subgoals, and objectives is provided on page 70 for reference purposes.

Map 3.3 Stillwater Alternative B Boundary and Ecological Zones



GIS Analysis by U.S. Fish and Wildlife Service

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Topics of Alternative B's Goals, Subgoals, and Objectives for Stillwater and Fallon NWRs

— A Hierarchical Outline —

- Goals (capital letters)
  - Subgoals (lower case letters)
    - Objectives (all others)

Stillwater NWR

- **A:** habitat for waterfowl/waterbirds
  - **A.a:** general wetland-habitat conditions
    - **A.a.1:** season and annual wetland-acreage
    - **A.a.2:** wetland-habitat type seasonal acreagess
    - **A.a.3:** within-community composition
    - **A.a.4:** levels of total dissolved solids
    - **A.a.5:** contaminants entering the marsh
    - **A.a.6:** mercury contamination
    - **A.a.7:** botulism and cholera potential
  - **A.b:** fall and winter habitat for waterfowl/waterbirds
    - **A.b.1:** submergent aquatic vegetation
    - **A.b.2:** moist soil vegetation
    - **A.b.3:** goose forage in farmland area
    - **A.b.4:** shorebird migration habitat
  - **A.c:** breeding habitat for waterfowl/waterbirds
    - **A.c.1:** emergent vegetation/open-water mosaic
    - **A.c.2:** additional habitat needs
      - **A.c.2(a):** hemi-marsh
      - **A.c.2(b):** dense nesting cover in uplands
      - **A.c.2(c):** nesting islands
    - **A.c.3:** breeding habitat for shorebirds
    - **A.c.4:** breeding habitat for other waterbirds
    - **A.c.5:** nest depredation
  - **A.d:** human disturbance
    - **A.d.1:** sanctuary
    - **A.d.2:** effects in public use areas
  - **A.e:** inventories, management studies, and research
- **B:** natural biological diversity
  - **B.a:** riparian and upland birds
    - **B.a.1:** needs of riparian birds
    - **B.a.2:** habitat for bald eagles
  - **B.b:** riparian and upland birds
    - **B.b.1:** needs of upland birds

- Goals (capital letters)
  - Subgoals (lower case letters)
    - Objectives (all others)

- **C:** opportunities for wildlife-dependent public uses
  - **C.a:** hunting
    - **C.a.1:** reasonable chance at success
    - **C.a.2:** safe experiences
  - **C.b:** environmental education and interpretation
    - **C.b.1:** adequate facilities
    - **C.b.2:** needs of teachers and students
  - **C.c:** wildlife observation and photography
    - **C.c.1:** adequate viewing/photography opportunities
  - **C.d:** opportunities for scientific research
    - **C.d.1:** foster relationship with research institutions
    - **C.d.2:** provide facilities

Fallon NWR

- **A:** Waterfowl and other waterbirds
  - **A.a:** general wetland-habitat conditions
    - **A.a.1:** wetland-habitat acreage target
    - **A.a.2:** nesting, brooding, feeding, & resting habitat
    - **A.a.3:** water chemistry
    - **A.a.4:** contaminants entering the wetlands
  - **A.b:** nest success and production of waterbirds
    - **A.b.1:** dense nesting cover
    - **A.b.2:** shorebird nesting habitat
    - **A.b.3:** nest depredation
  - **A.c:** human disturbance management
    - **A.c.1:** breeding season
    - **A.c.2:** fall and winter
- **B:** Other components of biodiversity
  - **B.1:** natural diversity in sand dunes
- **C:** opportunities for wildlife-dependent public uses
  - **C.a:** hunting
    - **C.a.1:** successful hunt
    - **C.a.2:** safe hunt
  - **C.b:** environmental education
  - **C.c:** wildlife observation and photography
  - **C.d:** scientific research

This outline of topics lists the main components of each goal and the relationships among goals, subgoals, and objectives. Goals A and B were guided by the needs of key groups of migratory bird species at key periods in their life history on Stillwater NWR. Subgoals under Goal A address broad habitat needs, and needs at two key seasons: fall/winter and the breeding season. Subgoals under Goal B address components of the area's biological diversity not addressed under Goal A. Subgoals under Goal C identify the priority public uses for which opportunities would be provided under Alternative B.

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3.4.B.2.2.1 Fish, Wildlife, and Habitat Management

Guiding Principles

Management of fish, wildlife, and habitat would be guided by the following principles under this alternative.

Habitat Conditions. This alternative would focus on providing for the habitat needs of key species and groups of species, thus maintaining a key species approach to managing Stillwater NWR. Key species would be similar to those identified under Alternative A (redheads, canvasbacks, tundra swans, white-faced ibis, and bald eagles) and would emphasize waterfowl. Shorebirds would be added to this list.

Priorities identified in the *1987 Management Plan for Stillwater Wildlife Management Area* would be modified somewhat to shift management emphasis to fall and winter waterfowl habitat, (primarily submergent aquatic and moist soil vegetation), as compared to emphasizing breeding habitat. Although both would be produced under Alternative B, higher importance would be placed on producing submergent aquatic vegetation as a food for fall-migrating and wintering waterfowl, as compared to seeds of annual plants (moist soil vegetation). This stems from the fact that both diving and dabbling ducks feed on submergent vegetation, whereas moist soil vegetation only feeds dabbling ducks. Nonetheless, moist soil vegetation would be made available to dabbling ducks because they prefer this food when given the choice. Furthermore, invertebrate communities in flooded moist soil units are generally more diverse than drawn down units containing aquatic submergent vegetation, thus providing greater benefits to spring migrants. An increased emphasis on moist soil vegetation would represent a shift from management under the 1987 plan.

An assumption under this alternative is that the biotic integrity and environmental health would be enhanced by providing high-quality habitat for waterfowl during the fall and winter and high-quality habitat for breeding waterbirds. In so doing, all wetland wildlife species would be enhanced.

General Approach to Producing these Habitat Conditions. In developing annual water plans, the order of priority for water use would be to (1) provide high-quality fall and winter habitat for waterfowl and waterfowl hunting; (2) provide seasonal drawdown and circulation of water to promote growth of sago pondweed; (3) sustain a high survival of emergent vegetation through drought years; (4) refill wetland units after draining them to dump salts and kill carp, and (5) provide breeding habitat for waterbirds. Figure 3.1 illustrates one of the ways in which the objectives of this alternative differ from the objectives developed for other alternatives.

Parallel with the guiding principles outlined above, habitat management would focus on the management tools that would most effectively produce the habitat conditions to meet the particular needs of the species or species' group of interest. Water management and prescribed burning would be the primary management tools, with a focus on producing submergent aquatic

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vegetation as well as summer drawdowns to promote moist soil vegetation. Water would also be used to maintain deep emergent vegetation. Other tools would include controlled livestock grazing, mechanical treatments, and possibly herbicides and explosives.

Compatibility. Under this alternative, compatibility determinations would evaluate the potential effects of public uses on wildlife species richness, key wildlife parameters (e.g., production, nutritional status), regional and flyway populations of migratory birds, and habitat diversity. Because no measurable adverse impacts to wildlife have been demonstrated for the existing public use program, it would be assumed that existing public uses are compatible.

Under this alternative, problems associated with human disturbance would be resolved as they arise. When a problem occurs for which limited site-specific information exists and solutions could involve cutting back on a particular use, a management study would be designed to investigate the cause-and-effects relationship between the particular use and the wildlife that appear to be impacted. Upon collecting and analyzing a sufficient amount of information, the public-use program would be modified accordingly. If the behavior of a particular wildlife species changes in response to human activities to compensate for potential losses (e.g., increased nighttime feeding), the potential effects of the activity would be considered a nonissue and would not affect the compatibility determination for the use being evaluated.

Monitoring. Recognizing the importance of a sound monitoring program in a successful management program, increased emphasis would be placed on monitoring the status and trends of fish, wildlife, and plant populations and their habitat on each refuge (Refuge System Admin. Act, Sec. 5(3)(N)). Priority in the monitoring program would be given to tracking long-term wetland-habitat acreage, and long-term waterfowl and shorebird data sets.

Objectives and Strategies

Goal A: Provide optimal feeding and resting habitat for waterfowl and other waterbirds, especially during fall migration and winter, and secondarily to provide optimal nesting, feeding, and resting habitat for these species during the breeding season.

Subgoal A.a: Provide wetland-habitat conditions that are generally beneficial to waterfowl and other wetland wildlife throughout the year, with an emphasis on fall/winter wetland-habitat. *(This subgoal primarily supports wildlife habitat needs identified under Subgoal A.b, but also supports wildlife needs identified under Goal B.)*

Objective A.a.1: Sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh, in a way that attains the following seasonal targets (see table below for actual acreages for representative inflow volumes):

- 80-100% of annual-peak acreage during October-March;
- 75-90% of annual-peak acreage during April-June, with highest acreage on April 1;
- 60-75% of annual-peak acreage during July-September.

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For several representative water-inflow levels, this translates to:

Annual Wetland Inflow (acre-feet)	Objective Wetland-Habitat Acres for Stillwater Marsh[A]			Objective Long-term Average
	Apr-Jun	Jul-Sep	Oct-Mar	
20,000	4,000-5,000 ≥4,500 April peak	3,000-4,000	4,500-5,500	—
35,000	6,000-8,000 ≥7,000 April peak	5,000-6,500	7,000-8,500	—
50,000	10,000-12,000 ≥11,000 April peak	8,000-10,000	10,000-13,000	—
60,000	10,000-14,000 ≥12,000 April peak	8,000-12,000	12,000-15,000	12,500[B]
spill-year	same as appropriate representative year above (according to average inflow during nonspill years), or more per season			—[B]

[A] Objectives assume that the previous year had the same or lower inflow volume. If it was higher, the stated objectives would be minimum acreages.

[B] The long-term objective for nonspill years (an average of 12,500 acres of wetland-habitat) years) assumes a long-term average of 16,500 acres during spill years (1 of 4 years), which would be needed to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. The 16,500-acre estimate for spill years is not an objective.

Basis of Objective: Maintaining a long-term average of 13,500 acres of wetland-habitat would contribute toward the target of 14,000 acres for the refuge. The objective also generally contributes toward goals and objectives of the Intermountain West Joint Venture Plan (Intermountain West Joint Venture 1995), as well as the Nevada Partners in Flight Bird Conservation Plan (Partners in Flight), and U.S. Shorebird Conservation Plan, Intermountain West Region (Oring and Neel 2000).

Strategies to Achieve Objective: A major strategy would be to continue acquiring water rights and securing other sources of water as outlined in the 1996 WRAP EIS and ROD. At the completion of the water-rights acquisition program, deliverable water (acquired water-rights and lease water-rights), would be delivered to Stillwater NWR in the following proportions of the annual volume (until completion of the acquisition program, low water-year proportions would be used).

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0%	0-20%	50-70%	20-40%
Full water-year	0%	20-40%	40-60%	10-30%
Spill year	0%	0-40%	50-70%	20-40%

In a full-water year, under this alternative, water would be delivered to attain peak wetland-habitat acreage in November (the end of the irrigation season), leading into a period of minimal evapotranspiration (<1 to 3 inches per month during November-February). Because a relatively small amount of water is needed to sustain wetland-habitat during these months (an estimated 4,000-8,000 acre-feet to sustain 16,000 acres), a large proportion of the peak acreage can be carried over to spring using only drainwater. At the start of the irrigation season, usually in the later half of March, a small amount of fresh water would be delivered to fill desired units, which would be maintained through May. At this time, water levels would be permitted to decline until about September when wetland units would again be filled leading into fall and winter. Therefore, in addition to providing the maximum amount of wetland-habitat for migrating and wintering waterfowl, a large amount of wetland-habitat would be available for the breeding season.

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In developing annual water plans, the order of priority for water use on Stillwater NWR would be to (1) sustain a high survival of emergent vegetation through drought years, (2) provide high-quality feeding and resting habitat for waterfowl and other waterbirds during the fall and winter, (3) provide high-quality nesting and brooding habitat, and (4) refill wetland units after draining them to dump salts or kill carp.

Water would be better controlled by enlarging and extending the West Canal to West Marsh, and possibly to Pintail Bay, which would greatly enhance independent management of wetland units. Other improvements to the system would include enlarging East Canal and Center Canal, extending the Goose Lake Bypass, and enlarging existing water-control structures. Some of the larger wetland units could be subdivided by additional diking. Extremely high or low flows of water through wetland units would be avoided by use of bypass canals. Open channels would be maintained by fire, physical means, or explosives in cattail and hardstem bulrush stands to permit movement of water and wildlife.

Monitoring Elements: Water receipts, wetland-habitat acreage by season.

Objective A.a.2: At a broad scale, provide a mix of wetland-habitat types throughout the marsh to provide for a wide spectrum of habitat needs of waterfowl and other water birds, with an emphasis on feeding habitat during the fall and winter and breeding habitat during the spring, by targeting the following mix of habitats, with intervening months being managed as transition periods.

Low-Water Conditions (seasonal range = 3,000 - 5,500 acres of wetland-habitat[A])

Habitat Type (and annual-peak depth)	Annual	Apr-Jun	Jul-Sep	Oct-Mar
Submergent marsh (1-3 ft)	20-45%	20-35%	30-45%	20-35%
Deep emergent marsh (1-3 ft)	20-45%	30-45%	30-45%	20-35%
Shallow emergent marsh (0.1-2 ft)	10-35%	10-25%	10-30%	20-35%
Wet Meadow (0.1-1 ft)	0-10%	0-5%	0%	0-10%
Moist-soil (0.1-1 ft)	0-10%	0-5%	0%	5-10%
Unvegetated Mudflat (0.1-0.5 ft)	5-10%	5-10%	7-10%	5-7%

[A] Assumes a full-water year with about 17,000 acre-feet of water available for wetland delivery (20,000 acre-feet of water rights acquired), or a shortage year at a later stage of the acquisition program, equivalent of this annual volume of water.

Moderate Water Conditions (seasonal range = 8,000 - 13,000 acres of wetland-habitat[B])

Habitat Type (and annual peak-depth)	Annual	Apr-Jun	Jul-Sep	Oct-Mar
Submergent marsh (1-3 ft)	20-40%	20-35%	25-40%	20-35%
Deep emergent marsh (1-3 ft)	20-40%	25-40%	30-45%	20-40%
Shallow emergent marsh (0.1-2 ft)	15-45%	15-35%	25-35%	25-45%
Wet Meadow (0.1-1 ft)	0-10%	0-5%	0-2%	5-10%
Moist-soil (0.1-1 ft)	0-20%	5-15%	0-3%	5-20%
Unvegetated Mudflat (0.1-0.5 ft)	5-10%	5-10%	5-10%	5-10%

[B] Assumes a full-water year with about 30,000 acre-feet of water available for wetland delivery (35,000 acre-feet of water rights acquired), or a shortage year at a later stage of the acquisition program, equivalent of this annual volume of water.

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High-water Conditions (seasonal range = 8,000 - 15,000 acres of wetland-habitat[c])

Habitat Type (and annual peak-depth)	Annual	Apr-Jun	Jul-Sep	Oct-Mar
Submergent marsh (1-3 ft)	15-40%	15-30%	30-40%	25-40%
Deep emergent marsh (1-3 ft)	15-45%	15-35%	30-45%	15-35%
Shallow emergent marsh (0.1-2 ft)	10-30%	10-25%	10-25%	20-30%
Wet Meadow (0.1-1 ft)	0-15%	5-10%	0-5%	0-15%
Moist-soil (0.1-1 ft)	5-30%	10-25%	5-10%	15-30%
Unvegetated Mudflat (0.1-0.5 ft)	5-15%	5-10%	5-15%	5-10%

[c] Assumes a full-water year with about 47,000 acre-feet of water available for wetland delivery (completion of water-rights acquisition program)

Objective A.a.3: On a finer scale, within each type of wetland-habitat, manage for plant species composition that best meets the needs of the representative species, according to season, by providing a mix of plant associations dominated by one or more of the following species:

Habitat Type	Dominant Species
(a) Shallow emergent marsh:	alkali bulrush, Baltic rush, common reed, and smooth scouring rush, and common-three-square
(b) Deep emergent marsh:	hardstem bulrush, southern cattail, and broad-leaf cattail
(c) Submergent marsh:	chara, coontail, horned pondweed, long-leaved pondweed, narrow-leaf pondweed, sago pondweed, western pondweed, widgeon grass, water hyssop, water milfoil, and duckweed
(d) Seasonal marsh:	bassia, swamp timothy, smartweed water-grass, and other annuals; saltgrass; and cattail, alkali bulrush, hardstem bulrush, common-three-square, and other perennial emergents
(e) Playa wetland:	no vegetation to sparse vegetation, water depths of less than one-foot at peak water levels, but usually drying by summer's end

Basis of Objectives: Objectives A.a.2 and A.a.3 generally support the objectives under Subgoals A.b and A.c, as well as other objectives, by maintaining a high level of wetland-habitat diversity for a range of waterfowl and other waterbird species. They would generally support objectives outlined in the Intermountain West Joint Venture Plan.

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Strategies to Achieve Objectives: Stillwater Marsh would be managed to provide a mix of wetland-habitats within relatively close proximity, which may require additional dikes to break up larger units. The following strategies, in addition to water management actions described above, would be undertaken to achieve Objectives A.a.2 and A.a.3.

To reduce turbidity, which can hinder growth of submergent marsh vegetation, (1) larger impoundments may be broken up by cross diking to reduce wave action, (2) carp would be controlled through strategic drawdowns and rotenone, (3) hardstem bulrush and cattail root stocks could be transplanted to further reduce scouring caused by wind (and would also contribute to breeding habitat), and (4) bypass canals would be used, rather than sending water through upper wetland units, because high flows could increase the amount of suspended matter.

In addition to water management, prescribed burning, livestock grazing, muskrat management, herbicides, mechanical methods, and explosives would be used to manage marsh vegetation. Prescribed burning and livestock grazing are discussed further under Objective A.c.1. When muskrat grazing begins to reduce emergent vegetation below the desired levels of this alternative, muskrat numbers would be reduced through a permit system. Muskrat trapping may be extensive at times (up to an estimated 40,000 animals trapped per year). European carp would be controlled, primarily through drawing down wetland units, to reduce the deleterious effects of high water turbidity on aquatic plant survival and production. Pesticides may be used on occasion.

An integrated weed management plan and integrated saltcedar management plan would be completed and would include: (1) continued control of saltcedar, perennial pepperweed (tall whitetop), and other noxious weeds, highest priority being based on importance of the area for achieving priority objectives; and (2) continued promotion of Stillwater NWR as a possible test site of the Chinese leaf beetle.

Integrated pest management is defined as "the control of pests utilizing a practical, economical, and scientifically-based combination of biological, physical, cultural, and chemical control methods" (30 AM 12.5). It is a balance approach which considers hazard to the environment, efficacy, costs, and vulnerability of the pest. "The ultimate goal is to eliminate pesticide use on Service lands and facilitate, where possible, and to encourage pest management programs that benefit trust resources and provide long-term, environmentally sound solutions to pest management problems on sites off of Service lands" (30 AM 12.3).

Control tactics may include: flooding or dessication; mechanical treatments , such as chainsawing, rooting, disking; prescribed burning (also to be addressed in a Fire Management Plan); introduction of host-specific insects, such as the Chinese leaf beetle; grazing or browsing by goats or sheep; and herbicides. Efforts would be made to form partnerships with adjacent landowners, other Federal and nonfederal agencies, and organizations to control undesirable vegetation at a landscape level. Noxious weeds would be controlled according to priorities identified in noxious weed control-zones.

Chemical control methods would be necessary during initial phases of control efforts and with broadly-distributed species, but chemicals would be used only when it is determined that they are the most appropriate management tool available. For example, tall whitetop is sporadically distributed at low densities. The control technique currently used is hand pulling individual plants as they are located. However, chemical control has been more effective as wider distribution of tall whitetop has occurred. No control methods are currently practiced for Russian olive or purple loosestrife. All of these species and other potential invasive species will be covered in the stations integrated pest management plan which will be completed concurrent with the comprehensive conservation plan.

Monitoring Elements: Seasonal acreage of each wetland-habitat type, within-community plant species composition, distribution and undesirable invasive vegetation, progress on release of the Chinese leaf beetle.

Objective A.a.4: Provide a range of water conditions throughout the marsh, from freshwater areas (less than 1,000 milligrams per liter (mg/L) total dissolved solids (TDS) to areas of highly alkalinity/salinity (e.g., up to 50,000 mg/L or more)).

Basis of Objective: Different plant and animal communities form in different water conditions. Providing a wide range of these conditions would maximize biodiversity.

Strategies to Achieve Objectives: The following strategies would be carried out to attain and sustain objective levels of TDS, and reduce and minimize contamination. Drainwater and water from groundwater pumping would be mixed with irrigation-quality water. Flushing flows through the marsh would be maximized during precautionary releases and spills from Lahontan Reservoir by implementing strategies described previously to flush salts and other dissolved solids.

Monitoring Elements: Monthly concentrations of TDS through measurements of specific conductance, at inflow points and various locations throughout marsh.

Objective A.a.5: Manage wetlands water on Stillwater NWR to maintain concentrations of potentially toxic trace elements below effect levels, identified below, while recognizing that maintaining concentrations below these levels in the refuge's wetlands is not attainable in all wetland units (e.g., wetlands lower on the hydrologic gradient) at all times of year (e.g., later in the summer when wetland-habitat acreage shrinks), or during all time periods (e.g., regional drought conditions) and recognizing that water chemistry characteristics of wetland inflows are largely a product of off-refuge conditions.

Fish and wildlife concern and effect concentrations for contaminants of concern on Stillwater National Wildlife Refuge, Churchill County, Nevada.

constiuent	effect concentration[a]	concern concentration[a]	reference[b]
ammonia (mg/L)	0.4	0.04	1
arsenic (μg/L)	40	-	2
boron (μg/L)	1,016	200	3, 4
copper (μg/L)	10	5	6
lead (μg/L)	3.5	1.0	7, 8
mercury (μg/L)	0.1	0.0006	9
molybdenum (μg/L)	790	28	5
selenium (μg/L)	3.0	1.0	10
zinc (μg/L)	32	-	11

[a] Effect were identified as such in literature or were associated with a major adverse effect (i.e., mortality), concern concentrations were identified as such in literature or were associated with non-lethal effects (i.e., reduce growth).

[b] 1, Russo (1985); 2, U.S. EPA (1985a); 3, Birge and Black (1977); 4, Birge et al. (1979b); 5, Eisler (1997); 7, U.S. EPA (1985b); 8, Wong et al. (1981); 9, Schwarzbach (1998); 10, Skorupa (1998); 11, U.S. EPA (1987)

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Basis of Objectives: A variety of environmental contaminants have been identified in water, sediment, and biological tissues on Stillwater NWR, as identified above. Elevated contaminant concentrations have the potential to compromise attainment of other refuge objectives, including restoration of natural biological diversity, maintenance of high-quality habitat, and production of waterbirds. Effect concentrations were so noted in published literature or were associated significant toxic effects to fish and wildlife, such as substantial mortality, reduced production, or teratogenesis. Concern concentrations were so noted in published literature or were associated with less severe observable effects, such as low-level mortality or decreased growth for limited time periods. The attainment of objectives for water chemistry, sediment, and biological tissues, as provided in the above table, would minimize the potential for contaminants to compromise other refuge objectives.

Strategies to Achieve Objectives: As discussed under Objective A.a.5, the acquisition of water, the management of drainwater, and regular flushing of marshes are expected to reduce concerns with dissolved solids. As such, it is anticipated that concerns with trace elements closely associated with dissolved solids, such as arsenic and boron, would also be reduced.

Previous sampling has demonstrated that the chemical quality of water varies with water delivery routes. The Service would continue to monitor water quality parameters in delivered water and review water quality data collected by other entities to identify those routes through which the water with the lowest concentrations of TDS and trace elements can be delivered. Use of routes providing the lowest concentrations of these elements would be emphasized, while use of routes providing water with higher concentrations of these elements would be de-emphasized.

Pesticides have been identified as a concern on Stillwater NWR. The Service (Nevada Fish and Wildlife Office) would conduct a review of pesticide use in Lahontan Valley and continue to review water quality data to determine extent and severity of concerns with pesticides. If deemed necessary, pesticide residues in major water delivery routes and drains would be monitored. If it is determined that pesticides have the potential to impair the achievement of refuge purposes, the Service would work with TCID and other entities to reduce pesticide transport to the refuge.

The Service would collect additional data to evaluate concerns with nutrients (including ammonia) and bacteria. If nutrients continue to be of concern, the Service would pursue source identification and work with appropriate entities (i.e., Natural Resource, Conservation Service, University of Nevada Cooperative Extension, and Nevada Division of Environmental Protection) to identify measures to reduce concerns with nutrient and bacteria transport to the refuge.

In some cases, exposure to contaminants in sediment and food chains represents the greatest hazard to fish and wildlife on Stillwater NWR. The acquisition of water is expected to reduce the risk with at least some of these contaminants. However, the degree to which concerns may be reduced are uncertain. The Service would continue to monitor contaminant contaminant concentrations in sediment and biological tissues to evaluate contaminant risk in wetlands and associated wildlife. Additional measures to reduce risk may be developed if warranted.

Monitoring Elements: Monthly concentrations of TDS through measurements of specific conductance, pH, turbidity, and dissolved oxygen. Water samples would be collected quarterly from major water delivery routes for analysis of total dissolved solids, major ions, nutrients, trace elements, and bacteria. To the extent possible, water quality data collected by other agencies would be used. If warranted, samples would be collected for pesticide analyses during periods of peak pesticide use. Monitoring of trace element concentrations in water, sediment, and biological tissues from selected Stillwater NWR wetlands every three years.

Objective A.a.6: Minimize the amount of mercury entering Stillwater NWR wetlands and reduce mercury levels in wetland sediments and biological tissues to non-hazardous levels.

Basis of Objective: Mercury has the potential to impair the Service's ability to achieve refuge goals and purposes.

Strategies to Achieve Objectives: The amount of mercury entering the Stillwater NWR wetlands would be minimized and mercury in wetland sediments and biological tissues would be reduced to non-hazardous levels. Through cooperation with EPA and the Ecological Services office of the Fish and Wildlife Service in Reno, the most appropriate means to reduce mercury concentrations and avoid any increased distribution of mercury contamination would be determined, and an operational plan would be developed and implemented. To assist in these efforts, the Service and EPA anticipate the development of a model to increase the understanding of mercury dynamics in Lahontan Valley wetlands. Some potential remedial considerations that would be considered include: (1) avoiding the use of certain water delivery routes to the refuge; (2) further evaluate the benefits and possible detriments of using precautionary releases and spills from Lahontan Reservoir; (3) using cattail stands to filter water entering the refuge; (4) de-emphasis of management of contaminated wetlands; (3) working with Bureau of Reclamation, TCID, and EPA to identify and explore options of conducting releases from Lahontan Reservoir for deliveries and for precautionary releases that would minimize transport of mercury from Lahontan Reservoir; and (5) implementation of measures to reduce the biological availability of mercury.

Monitoring Elements: Monthly concentrations of TDS through measurements of specific conductance, at inflow points and various locations throughout marsh, mercury loading at designated sites.

Objective A.a.7: Minimize the occurrence, spread, and severity of botulism and cholera outbreaks.

Basis of Objectives: Waterbird diseases such as type C botulism and fowl cholera have the potential to impact populations of waterbirds using the Stillwater NWR Complex. These diseases are occur seasonally. Cholera typically occurs during winter and botulism during hot summer months. Past die-offs have been as high as 55,000 birds, which resulted from a suspected combination of botulism and cholera. diminish the contribution of Stillwater NWR wetlands to achieving Intermountain West Joint Venture goals and objectives. In addition to direct mortality, waterbird use of refuge wetlands can be severely impacted at this level of effect because control efforts (e.g., use of airboats) tend to push remaining birds into isolated and often less-desirable habitat. Botulism and fowl cholera can diminish the contribution of Stillwater NWR wetlands to achieving Intermountain West Joint Venture goals and objectives.

Strategies to Achieve Objectives: Botulism and cholera monitoring and cleanup would be continued as it has in the past, with botulism patrols initiated by mid-June and continuing into early fall. Wetland units with a history of botulism problems would be identified and targeted for regular airboat patrols, with more frequent patrol efforts initiated as outbreaks are discovered. Fall, winter, and early spring patrols would be conducted in more remote areas such as the Carson Sink and where large concentrations are identified through aerial surveys. Carcasses would be immediately removed from wetland units and sick birds would be transported to the refuge "duck hospital" where rehabilitation would be conducted using fresh uncontaminated water in the holding pen.

Water management would be used to minimize the severity of botulism outbreaks by minimizing water-level fluctuations during summer months. Under this alternative, sufficient water would be available to reduce the risk of botulism outbreaks — not only would water levels not be dropping during hot summer months, water levels in many wetland units would be rising during this period. Where outbreaks occur, wetland-unit flushing or draining could be used to either dilute contaminated units (through flushing) or to reduce the desirability of the unit to susceptible waterbirds (e.g., through draining the unit). Portable Cristafulli pumps would be used to facilitate wetland-unit draining.

Monitoring Elements: Botulism and cholera occurrence by wetland unit, annual number of waterbirds, by species, that die annually due to botulism and cholera.

Subgoal A.b: Enhance, develop, and maintain high-quality fall and winter feeding and loafing habitat for waterfowl and other species using Stillwater NWR. *(The following objectives and strategies are in addition to those outlined for Subgoals A.a and A.d.)*

Objective A.b.1: Annually produce dense stands of submergent aquatic vegetation in 20 to 35 percent of the available fall/winter wetland-habitat (up to 40 percent at the completion of the water-rights acquisition program), and make this readily available to provide a high-quality food source for migrating and wintering waterfowl, especially diving ducks and tundra swans.

Basis of Objective: Aquatic submergent vegetation (in the "submergent marsh" zone of Objective A.a.3) is the most important food source at Stillwater NWR, and one that traditionally has attracted migrating redheads, canvasbacks, and other diving ducks, as well as tundra swans, which are key species under this alternative and species that have been the focal point of management at Stillwater NWR. This food source is also used by dabbling ducks. Therefore, producing extensive stands of this vegetation is critical to achieving Goal A.

Strategies to Achieve Objectives: To facilitate feeding by diving ducks and swans, production of aquatic vegetation would initially be optimized by elevating water levels before the end of the growing season and retaining water flow. Maintaining relatively high-water levels would reduce access by coots, which can considerably deplete aquatic

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vegetation prior to the waterfowl migration. Maintaining high elevations would be followed by a gradual lowering of unit wetland depths during the period when waterfowl are at peak numbers during the fall. This could be accomplished as part of draw-down plans for units and to facilitate flushing salts from wetland units that are lower down in the system. Because swans tend to stay longer, water flow through impoundments may have to be maintained to prevent ice from covering all food supplies.

Monitoring Elements: Acreage and within-community density of submergent vegetation-dominated habitats, and response by waterfowl (e.g., waterfowl use-days).

Objective A.b.2: Annually provide up to 25 percent of the available fall/winter wetland-habitat acres (up to 30 percent at the completion of the water-rights acquisition program) as shallowly-flooded areas dominated by annual, seed-producing plants to provide migrating and wintering dabbling ducks with a high-quality food source.

Basis of Objective: Although submergent aquatic vegetation can be heavily used by dabbling ducks, shallowly-flooded areas of annual, seed-producing plants (in the "seasonal marsh" zone of Objective A.a.3) is preferred by these ducks. Producing a sufficient amount of this food is important to achieving Goal A.

Strategies to Achieve Objectives: Flooding areas dominated by seed-producing annuals would provide carbohydrates and fat for higher maintenance requirements of dabbling ducks during the winter and for migration. To obtain the desired feeding habitat, water levels in certain wetland units would be drawn down during the summer to promote germination of annual weeds. These units would then be slowly flooded during the fall and early winter, ensuring that water depths in areas with annual weeds does not exceed eight inches. Slow staging of water levels would provide a continual supply of new habitat at optimal levels. Previously exploited food resources would become unavailable (in deeper water) while unexploited food becomes available. Then, during the late winter and spring, these units could be drawn down, which would create a concentration of invertebrates at a time when waterbirds are actively attempting to acquire protein. East and West Pastures in the sanctuary would be key areas for this practice.

Monitoring Elements: Acres of moist soil vegetation available, and response by waterfowl (e.g., waterfowl use-days).

Objective A.b.3: Annually produce winter forage in the farmland area sufficient to supplement the diet of arctic-nesting Canada geese.

Basis of Objectives: The Intermountain West Joint Venture Plan generally calls for wintering and migrational habitat to be provided for Canada geese in the focus areas of the Intermountain West, of which Stillwater NWR is a component.

Strategies to Achieve Objectives: The Service would work to provide forage crops for Canada geese (e.g., alfalfa, wheat, oats) in the area of Stillwater NWR by providing these crops on the refuge. Up to 400 acres of alfalfa, wheat, oats, or other crop would be provided as forage for wintering Canada geese on the refuge. However, water and water rights acquired under subsection 206(a) of Public Law 101-618 would not be used to irrigate crops in the farmland area, except possibly after water-rights have been acquired but before they have been transferred to the wetlands. Because the Service would not acquire additional water rights for use on farmlands or for other agricultural purposes, other sources of water would be needed for these crops, such as temporary transfers by farmers in a cooperative farming program.

Before the arrival of Canada geese, the crops would be harvested, grazed by cattle, or both to ensure that vegetation is at an optimal height for goose browsing. Cattle grazing would also be used to control weeds along fields and ditches in the farmland area. Although cattle grazing may be used to enhance goose browse and control weeds in the farmland area of the refuge, it would not be used for these purposes outside the farmland area.

Monitoring Elements: Acres of farmland cultivated for the purpose of providing goose forage and the number of geese using the fields.

Objective A.b.4: Provide high-quality shorebird habitat during spring and fall migration, based on best management practices for shorebirds.

Basis of Objectives: Stillwater Marsh and other wetlands in the Lahontan Valley are components of the Western Hemispheric Shorebird Reserve Network, stressing the importance of contributing to the international effort to conserve shorebird populations. In some years the Lahontan Valley wetlands provide stopover habitat for about half of North America's population of long-billed dowitchers. Providing high-quality habitat for shorebirds would also contribute toward accomplishment of goals and objectives in the U.S. Shorebird Management Plan.

Strategies to Achieve Objectives: Under this alternative, shorebird feeding and loafing habitat would be provided during spring and fall migrations through water management practices identified under Subgoal A.a. Under this alternative's water-management strategy, mudflat habitat would be provided in several areas of the refuge, associated with declining water levels in the spring and rising water levels in the late summer and fall. Monitoring would be undertaken to determine whether adequate habitat is provided for migrating shorebirds at appropriate times. Planning, monitoring, and other aspects of wetland management would be coordinated with the National Shorebird Conservation Plan, Intermountain West Region.

As recommended in the Nevada Partners in Flight Plan for avocets, at least one wetland-unit would be managed to ensure that there are mature invertebrates by April 1 each year, followed by gradual drawdown from April 1 through May 10.

Monitoring Elements: Acreage of mudflat and other shorebird migration habitat, and number of shorebirds during spring and fall migrations.

Subgoal A.c: In the wetland-habitat that is available during the breeding season, maximize nesting success and production of waterfowl and other waterbirds. *(The following objectives and strategies are in addition to those outlined for Subgoals A.a and A.d.)*

Objective A.c.1: At a broad scale, enhance, develop, and maintain feeding, loafing, nesting, and brooding habitat by distributing water to produce and maintain the following proportions of wetland-habitat in order to support a diversity of migratory birds and resident wildlife (see representative species below) using these habitats:

Proportion of Marsh	Type of Wetland-habitat	Representative Wildlife
30%	deep-water emergent marsh	coots, grebes, ibis, egrets, herons, and, Canada geese
35%	shallow emergent, seasonal, and playa wetland-habitat	mallards, green-winged teal, rails American avocets, and snowy plover
35%	hemi-marsh (50% submergent marsh and 50% deep and shallow emergent marsh)	redheads, canvasbacks, bitterns

Objective A.c.2: Within each habitat type, produce the habitat conditions that would best meet the needs of representative species of waterfowl and other waterbirds (redheads, mallards, green-winged teal, white-faced ibis, American avocets).

Objective A.c.2(a): In the hemi-marsh, produce and maintain an interspersion of open water and cover at a ratio of 50:50, and:

(i) Ensure that dense, residual emergent vegetation is available near open water for nesting redheads (and other species such as ruddy ducks and white-faced ibis).

(ii) Ensure that sufficient openings are provided in emergent vegetation near the shoreline to facilitate dabbling ducks nesting in adjacent uplands.

Basis of Objective: Both open water and emergent vegetation are needed for several species of breeding waterfowl and other waterbirds. With too little of one or the other, or with too large a homogeneous block of one or the other, the density of nesting pairs can be diminished. A mosaic of both is ideal for redheads and other species that nest in emergent vegetation.

Strategies to Achieve Objective: The following strategies would supplement those outlined under Objectives A.a.2-3. To enhance and sustain redhead production and production of other birds, including herons, egrets, bitterns, white-faced ibis, and rails, retaining emergent vegetation would be emphasized. At least one dense, mature stand of hardstem bulrush would be maintained in half the wetland units. Although providing high-quality nesting and brooding habitat for redheads would be a major objective of water management, attempts to maintain water levels for production would be abandoned in scarce water years. In low-water years, available water would be used to provide migration and wintering habitat, which would provide an additional boost for the following nesting season.

To the extent that hemi-marsh habitat is not sustained in the desired mosaic of emergent vegetation (50 percent) and open-water (50 percent) through water management, differences in soils and water depths, and muskrat grazing, the following techniques would be used in order of priority: (1) prescribed burning, (2) livestock grazing, (3) mechanical treatment, and (4) muskrat trapping (if muskrat grazing begins to reduce emergent vegetation below desired levels). Herbicides and explosives would only be used to reduce vegetation in canals and to facilitate water flow through wetland units.

When prescribed burning or cattle are used to create hemi-marsh habitat in extensive stands of dense emergent vegetation, the prescription would be designed to ensure that emergent vegetation survives in mosaics. Additional fencing may be required around some units to facilitate the use of cattle to create openings in dense emergent vegetation. Prescribed burning may also be used to remove accumulations of dead plant material over extensive areas of the marsh when such residual vegetation is inhibiting new growth or when new vegetation is desired. In these cases, prescriptions would be designed to not kill any vegetation (e.g., by burning over shallow water). In some cases, particular areas of the marsh may be burned every three to five years. Habitat management zones would be created.

During the breeding season, water would be managed to maintain shallow, nonfluctuating water depths in nesting areas to promote growth of submergent vegetation sufficient in amount and density to support floating nests. A major part of providing high-quality habitat for dabbling ducks would be the management of water to promote dense stands of saltgrass. Nesting islands would be constructed.

Monitoring Elements: Acres of seasonal wetland-habitat types, measure emergent: open water ratio and mosaic, and/or waterbird response (e.g., number of nesting pairs, number of ducklings, annual production).

Objective A.c.2(b): Enhance and maintain dense nesting cover for mallards, green-winged teal, gadwall, and other waterfowl in areas close to brooding habitat.

Basis of Objectives: Waterfowl nesting studies have repeatedly shown that higher nest success in dabbling ducks is associated with dense nesting cover.

Strategies to Achieve Objectives: When saltgrass becomes decadent under this alternative, it would be burned through prescription or grazed by cattle. This practice could be done every five to ten years. Desired levels of cattle grazing on Stillwater NWR would be achieved over a period of three years.

Nesting islands may also be constructed to facilitate nesting by dabbling ducks.

Monitoring Elements: Acres of dense nesting cover available for nesting, and/or response by waterfowl (e.g., number of ducklings, annual production).

Objective A.c.2(c): Construct up to ten nesting islands for upland nesting waterfowl species within the next five years.

Basis of Objectives: Studies have demonstrated that nests on islands are more successful than nests in nearby uplands.

Strategies to Achieve Objectives: Nesting-island design criteria would be explored and a design completed. After nesting islands are constructed, nesting success would be monitored to assess whether additional islands should be constructed.

Monitoring Elements: Number of islands constructed, frequency of use of nesting islands for nesting and nest success, as compared to nest success in uplands.

Objective A.c.3: Provide high-quality nesting and brood-rearing habitat for shorebirds, especially American avocets (targeting 1,500 pairs in full-water years), and snowy plovers (to contribute significantly to the State-wide target of 900 adults), targets based on the Nevada Partners in Flight Plan.

Basis of Objectives: Stillwater Marsh and other wetlands in the Lahontan Valley are components of the Western Hemispheric Shorebird Reserve Network, stressing the importance of contributing to the international effort to conserve shorebird populations. The Lahontan Valley wetlands provide important breeding habitat for American avocets and snowy plovers, key species identified in the Nevada Partners in Flight Plan. The snowy plover is a species of special concern. Providing high-quality habitat for shorebirds would also contribute toward accomplishment of goals and objectives in the U.S. Shorebird Management Plan, in particular, the habitat goal for "marshes and lakes."

Strategies to Achieve Objective: Water management prescribed under Objectives A.a.1 would be adjusted to contribute to objectives, strategies, and actions in the Nevada Partners in Flight Plan for snowy plover and American avocet. Particular attention would be paid to flooding at least one major alkaline playa for snowy plover nesting each year (an action in the Nevada Partners in Flight Plan). The nesting habitat needs of snowy plovers would be studied, and periodic censuses would be coordinated with other agencies and groups involved in snowy plover recovery efforts.

For American avocets, at least one extensive area of saltgrass would be flooded to a constant depth of two to six inches from April 15 through August 1. Predation of chicks and eggs would be monitored, and remedial action would be taken if predation levels exceed 50 percent. (Nevada Partners in Flight Plan)

Providing an average of 13,500 acres of wetland-habitat in Stillwater Marsh as prescribed under this alternative, including the above strategy for snowy plovers and American avocets, would provide a considerable amount of breeding habitat for other shorebirds. Other shorebird species may be added to the key species list after further examination.

Monitoring Elements: Acres of habitat provided during the breeding season, and response by shorebirds (e.g., breeding population, annual production), shorebird breeding-population survey to be coordinated with other agencies (Nevada Partners in Flight Plan).

Objective A.c.4: Ensure that suitable wetland-habitat is provided for other marsh-dependent species — particularly, white-faced ibis, black tern, American white pelican, Clark's grebe, and short-eared owl — during the breeding season.

Basis of Objective: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which white-faced ibis, American white pelican, Clark's grebe, and short-eared owls are identified as key species.

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Strategies to Achieve Objectives: This objective should be met in large part through the accomplishment of objectives under Subgoal A.a and Objectives A.c.1-3 above. For example, some of the specific objectives and strategies identified in the Nevada Partners in Flight Plan include (a) maintaining constant water levels (12 to 24 inches) in certain hardstem bulrush units from April 15 through August 15 for white-faced ibis nesting; (b) providing foraging habitat at Stillwater NWR for white pelicans; and (c) maintaining semi-permanent marsh with well-developed emergent and submergent plant communities, abundant populations of small fish, and relatively stable water levels from May 1 through November 15 for Clark's grebes. These conditions would be provided through implementation of the aforementioned strategies, but monitoring would be undertaken to determine whether adequate habitat is provided for these species.

Other actions, identified in the Nevada Partners in Flight Plan, to provide for the needs of waterbirds are as follows. Nongame fish in Stillwater Marsh would be actively managed for white pelicans to the extent that this does not conflict with other objectives. Holding water levels at high levels during the spring would be avoided to the extent possible.

Wetland units that historically produce few ducks could be lowered or held below operational levels until June, and could be managed to encourage and sustain forage fish. During spring, moving water attracts carp where they concentrate in canals; excess water could be used to maintain spring flows for this purpose. Flooding of abandoned units, especially those that are vegetated, would trigger fish spawning, and if sufficient water is available, these units could be maintained for an additional year.

Although wetland units would not be managed to enhance tui chub populations, it is assumed that tui chub would prosper in most units. To the extent that this is found not to be true, management of one or more wetland units could be tailored to encourage tui chub. Tui chub may be stocked occasionally to supplement existing populations. European carp and other introduced fish species would be controlled primarily through drawing down wetland units. Nonnative fish species would but not be stocked or otherwise introduced into Stillwater NWR.

To ensure that foraging areas are provided for short-eared owls, residual stands of emergent marsh vegetation would be dried for an extended period to build up the vole population so that it is high during the period March 1 through July 1.

Habitat needs of the species listed above would be examined further to determine other appropriate management actions to meet their needs. A review would be conducted to determine if other key species should be added to the list for Stillwater NWR.

Monitoring Elements: Distribution and acreage of wetland-habitat types, and response by waterbirds (e.g., breeding populations, annual production).

Objective A.c.5: Minimize the effects of nest depredation on nesting success of waterfowl, shorebirds, and other waterbirds.

Basis of Objectives: Waterfowl, redheads and canvasbacks in particular, are a primary management focus under this alternative. Depredation of nests appears to be having a marked effect on the production of waterfowl and other waterbirds.

Strategies to Achieve Objectives: A predator control program would be designed and implemented to enhance nest success and production of waterfowl, shorebirds, and other waterbirds. The main target species would be common ravens, although other nest predators could be included. Methods could include trapping, shooting, and in extreme cases, poisoning.

Monitoring Elements: Waterfowl and shorebird breeding pair numbers compared with waterfowl brood counts.

Subgoal A.d: Ensure that recreational and other uses do not adversely impact nesting waterbirds, and that opportunities for recreational and other uses are managed to minimize impacts to waterbirds and other wildlife during the remainder of the year.

Objective A.d.1: Provide high-quality feeding and resting habitat for waterfowl and other waterbirds in a sanctuary area (minimum of 4,000 acres of the refuge's wetland-habitat), to ensure that food is available to waterbirds outside the hunt area, and manage access in the hunt area to minimize human disturbance to waterfowl, while still meeting objectives for hunting.

Basis of Objective: An important part of high-quality habitat in an area that is used for recreational activities is sufficiently low levels of human disturbance to allow waterfowl to use the food that is produced. It generally supports Subgoal A.b and habitat objectives (e.g., A.b.4, A.c.2, A.c.3). One way to accomplish this is to provide a sanctuary containing high-quality feeding and resting habitat.

Strategies to Achieve Objective: During the hunting season, roads that are now closed would continue to be closed to reduce access and disturbance (Map 3.4). The sanctuary area south of Division Road would remain intact, and dabbling duck foraging habitat would be enhanced by flooding East and West Pastures during fall and winter. The northern one-third of Pintail Bay and a 100-yard wide band at the north end of North Nutgrass would be closed under this alternative (strategy under objective C.a.1), and this would provide some additional sanctuary for waterfowl. A minimum of 4,000 acres of wetland-habitat would be provided in the sanctuary. If total wetland-habitat acreage for Stillwater NWR is less than 4,000 acres, hunting would not be permitted that year.

Additional boating regulations would be imposed under this alternative. During the waterfowl hunting season, the maximum horsepower (hp) of boats would be set at 15, which is higher than existing boating regulations, and airboats would not be permitted.

Monitoring Elements: Wetland-habitat acreage inside and outside sanctuary by season; distribution and use of habitats by waterbirds; coordinated research effort to elucidate human/waterfowl interactions during hunting season; and distribution and density of refuge visitors, by activity and season (from public-use monitoring program).

Objective A.d.2: Minimize the adverse effects of human disturbance to waterbirds during the nesting and brooding seasons, while still providing opportunities for environmental education, wildlife observation, and other wildlife-dependent recreational uses.

Basis of Objectives: Many waterbird species are particularly sensitive to disturbance during the breeding season and desire nest sites which are remote and relatively disturbance free. Human activities (whether public use or research related) tends to compound natural levels of disturbance to which these species have adapted. In accordance with the Refuge Improvement Act, the basis of this objective would be to ensure that wildlife comes first while still providing opportunities for wildlife-dependent recreation.

Strategies to Achieve Objectives: All of Stillwater NWR, except designated tour routes, would be closed to all public uses from April 1 through July 31 each year to protect nesting birds from disturbance. The wildlife viewing areas at Stillwater Point Reservoir and the Kent and Weishaupt sites would remain open, as would a tour loop through part of Stillwater Marsh. The existing tour route and East and West County Roads would be the only access available to the public during this period. Except at designated locations, visitors would not be permitted off the roads. All other roads of the refuge would be closed to the public during this period.

From August 1 through the beginning of waterfowl hunting season, boating would be limited to nonmotorized craft. At all times of the year, Service personnel would minimize boating in the marsh while still completing necessary efforts to accomplish the goals and objectives under this alternative.

Monitoring Elements: Public-use monitoring (use levels, distribution, density), and response by birds.

Subgoal A.e: Design and conduct monitoring programs, management studies, and research to fill information gaps, assess the effectiveness of management actions, and to ascertain needed modifications to the management program. An initial set of objectives is as follows.

Objective A.e.1: Design a monitoring program and management studies that would address limiting factors associated with production, feeding, and resting habitat for waterfowl and other wildlife.

Objective A.e.2: Research ways to provide wetland-unit drawdowns during July-September in ways that accomplish habitat objectives, but do not contribute to significant avian botulism outbreaks (from Nevada Partners in Flight Plan).

Objective A.e.3: Participate in the comprehensive state-wide survey of potential nesting sites of black terns using professional and volunteer personnel, as well as conduct an assessment of the role that Stillwater Marsh played in black tern ecology in the Great Basin (from Nevada Partners in Flight Plan).

Objective A.e.4: Provide research opportunities for universities and other educational institutions.

Basis of Objectives: Additional information is needed to achieve refuge goals, subgoals, and objectives, and to assess the effects of Alternative B on particular species. Some of the objectives were adopted from the Nevada Partners in Flight Plan.

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Strategies to Achieve Objectives: Specific strategies would be outlined in a biological monitoring program.

Monitoring Elements: Completion of investigations and tracking of monitoring efforts.

Goal B: Restore and maintain natural biological diversity.

Under Alternative B, it would be assumed that the achievement of subgoals and objectives under Goal A would generally address the goal to restore and maintain natural biological diversity in Stillwater Marsh. The following subgoals and objectives would address the biological diversity in other ecological zones (e.g., riparian areas and uplands), with an emphasis on native species richness. The following subgoals, objectives, and strategies were developed in consideration of the objectives, strategies, and actions outlined in the Nevada Partners in Flight Bird Conservation Plan (Partners in Flight 1999).

Subgoal B.a: Provide suitable habitat for migrating, breeding, and birds (including threatened and endangered species) in riparian areas and salt desert shrub communities in ways that are consistent with the overall approach prescribed under Goal A.

Objective B.a.1: Provide suitable habitat for yellow-billed cuckoos, ash-throated flycatchers, blue grosbeaks, yellow-breasted chats, western bluebirds, and other riparian birds.

Basis of Objectives: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which yellow-billed cuckoos, ash-throated flycatchers, blue grosbeaks, yellow-breasted chats, and western bluebirds were identified as key species pertinent to Stillwater NWR.

Strategies to Achieve Objectives: The main strategy would be to restore riparian habitat along the Stillwater Slough. A baseline survey of the slough would be conducted to determine the geomorphology and riparian habitat that could be supported. Based on this assessment, objectives and more specific actions would be determined, and an operational plan would be prepared.

Native vegetation would be reestablished through practices such as seeding, planting seedlings and cuttings, in addition to fostering and allowing natural colonization and recruitment. Revegetation objectives and strategies for riparian would be detailed in the operational plan. The plan would include specify that local sources of native species (e.g., seeds and cuttings collected locally) would be emphasized and species not native to the Lahontan Valley would be avoided in all revegetation efforts and other plantings. Seedlings and cuttings would be protected from mule deer, beaver, and other herbivores, and beaver may need to be trapped or other means may be used to reduce tree loss.

Management actions under this alternative to restore riparian habitat along the Stillwater Slough would be consistent with the major strategies in the Nevada Partners in Flight Plan, which are to (1) maintain and increase large contiguous blocks of multi-storied cottonwood-willow forests; (2) maintain and enhance mature stands of cottonwood/willow and buffaloberry, and (3) maintain thriving buffaloberry stands mixed with cottonwood and/or willow stands on lowland river floodplains.

Monitoring Elements: Amount (acres/miles) and quality (composition, structure) of restored riparian habitat, and bird response to available habitat (e.g., species richness, relative abundance of representative species).

Objective B.a.2: Within the next five years, reestablish, a way favorable for future roosting by bald eagles (including a suitable distance from areas accessible by the public), cottonwood trees at the southern end of Stillwater NWR.

Basis of Objectives: Bald eagles are a federally-listed threatened species and Stillwater NWR would, under Alternative B, contain one of their most important roost sites.
Strategies to Achieve Objectives: Cottonwood trees would be reestablished along Stillwater Slough and other suitable locations for bald eagles, both as daytime perch trees and for night roosts. As part of the effort to reestablish cottonwood communities, emphasis would be placed on reestablishing cottonwoods in areas that would provide suitable roosting habitat for bald eagles. (Foraging habitat needs would be provided as a consequence of achieving objectives under Goal A.)
Monitoring Elements: Acres of initiated restoration, riparian habitat acreage suitable as bald eagle roost sites, and bald eagle response (e.g., number of roosting bald eagles).

Objective B.a.3: Provide suitable habitat for loggerhead shrike, burrowing owls, and other upland wildlife.

Basis of Objectives: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which loggerhead shrike and burrowing owls were identified as key species.
Strategies to Achieve Objectives: The Nevada Partners in Flight Plan also calls for loggerhead shrike habitat to be protected. Although no active management would be undertaken to enhance or manage upland habitats (other than restoration efforts in former farm fields and fire suppression efforts), this habitat would be maintained for the benefit of loggerhead shrikes, burrowing owls, and other wildlife. Native upland vegetation would continue to be reestablished in some former farmland through practices such as seeding and planting seedlings, in addition to fostering and allowing natural colonization and recruitment. Revegetation objectives and strategies for previously farmed areas would be detailed in an operational plan. The plan would include the provision that local sources of native species (e.g., seeds and cuttings collected locally) would be emphasized and species not native to the Lahontan Valley would be avoided in all revegetation efforts and other plantings. An exception would be in the farmland zone where agricultural crops could be planted. During the interim, while the operational plan is being developed, acquired farmland within the refuge would continue to be revegetated to native vegetation and the ground would be recontoured where possible.
Monitoring Elements: Acres of upland habitat types.

3.4.B.2.2.2 Public-Use Management

Guiding Principles

The management of public use under this alternative would be guided by the following principles. As in Alternative A, hunting would continue to be emphasized over the other priority public uses. However, facilities for other uses would be developed to provide more balance among recreational opportunities. This balance recognizes that compatible wildlife-dependent recreation is important for developing an appreciation of fish and wildlife by the American public. Wildlife-dependent public uses would be encouraged, as clearly spelled out in the Service's vision document "Fulfilling the Promise"(USFWS 1999) and Refuge System Administration Act. Programs would only be provided to the extent that funding and staffing is available, but efforts would be made to enhance environmental education and interpretive efforts through the development of additional programs and remodeling of existing structures, as well as construction of informational kiosks and observation sites. Traditional uses of the area, such as camping, horseback riding, and hiking would be allowed to continue, but would not be encouraged.

Objectives and Strategies

Goal C: Provide opportunities for environmental education and wildlife-dependent recreation that are compatible with refuge purposes and Refuge System mission.

Subgoal C.a: Provide opportunities for high-quality hunting experiences.

Basis of Subgoal: Hunting is a wildlife-oriented recreational activity, and one of the purposes of Stillwater NWR is to provide opportunities for wildlife-oriented recreation. As one of the priority general public uses of the Refuge System, hunting must receive enhanced consideration during the planning process. The Service is encouraged under the Refuge System Administration Act to find ways to allow wildlife-dependent recreation on refuges. Hunting is recognized as a traditional, family-oriented form of recreation, and important in the development of an appreciation for fish and wildlife.

Objective C.a.1: Provide hunting opportunities where hunters would have a reasonable chance of success.

Basis of Objective: Having a reasonable chance of success is a major criterion for a high-quality hunt by many people.

Strategies to Achieve Objective: This alternative would continue to maintain hunting as an integral part of the recreation program. At the completion of the water-rights acquisition program, it is anticipated that up to about 9,200 acres (about 65 percent) of the fall and winter wetland-habitat in Stillwater Marsh would be open to waterfowl hunting under this alternative (Map 3.4). All wetland units north of Division Road would be open to waterfowl hunting during the hunting season, except that the northern one-third of Pintail Bay and a 100-yard wide strip along the north edge of North Nutgrass unit would be closed to enhance hunting opportunities at the northern end of Stillwater NWR.

Nonmotorized watercraft, boats with electric motors, and boats with motors up to 15 horse power would be allowed in all open areas during the waterfowl hunting season. Overnight stays, in association with hunting activities, would be allowed on-site, such as at boat launches and parking areas, and would only be allowed during the hunting season.

Monitoring Elements: Numbers of hunters, feedback on the quality of the hunting experience.

Objective C.a.2: Ensure that hunting experiences are safe.

Basis of Objective: Beyond being a vital consideration in the management of any public use, the Refuge System Administration Act requires that wildlife-dependent recreation be allowed only to the extent they is consistent with public safety.

Strategies to Achieve Objective: If hunter densities begin to approach unsafe levels, hunter density thresholds may be established. Otherwise, such thresholds would not be established.

Monitoring Elements: Number and types of reported and observed injuries per hunting season, observations by staff of unsafe practices and law enforcement violations.

Subgoal C.b: Provide opportunities for an experience in environmental education and interpretation that generally meet the needs of users.

Basis of Subgoal: Providing opportunities for environmental education was specifically identified as one of the purposes of Stillwater NWR. Furthermore, the Refuge System Administration Act encourages the Service to provide opportunities for the priority general public uses of the Refuge System. Environmental education and environmental interpretation are two of the six priority public uses. These opportunities are provided in the Refuge System to advance public awareness, understanding, and appreciation of the functioning of ecosystems and the benefits of their conservation to fish, wildlife, and people. This ultimately contributes to the mission of the Refuge System.

Objective C.b.1: Develop adequate facilities and equipment for environmental study and interpretation within the nonhunting, general public-use area of the refuge.

Basis of Objective: There are currently no facilities on-site at Stillwater NWR. The development of such would greatly enhance the capability of the Service to administer its public use programs, and ultimately achieve the public use goal of the refuge.

Strategies to Achieve Objective: A visitor contact station and environmental education site would be located on Stillwater NWR at a site yet to be determined. Properties formerly owned by the Weishaupt and Kent families are being considered. The facility at the decided upon location would include an administrative office, visitor contact station, environmental education site, and a maintenance shop capable of housing refuge maintenance vehicles and boats.

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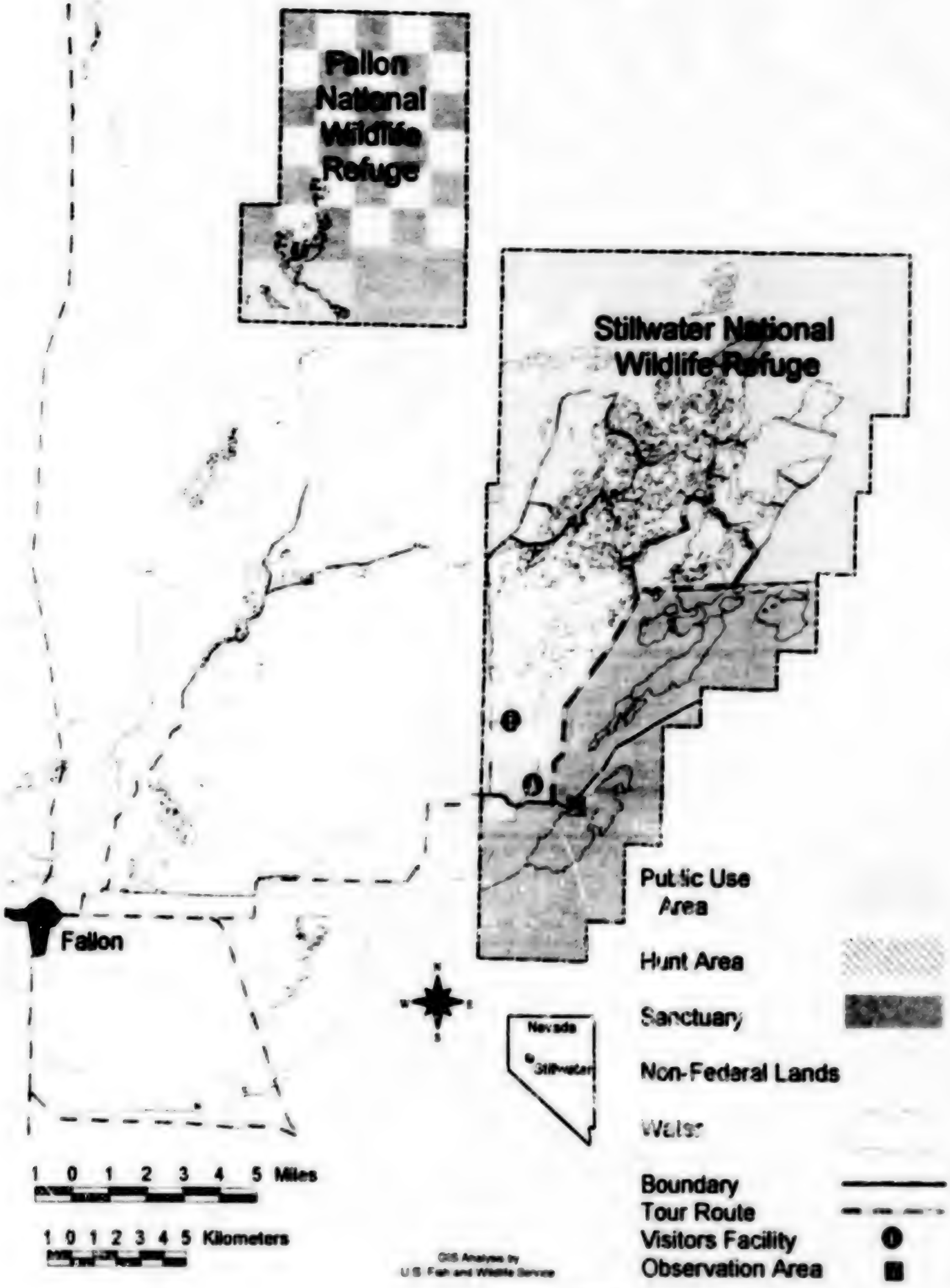
Map 3.4 Stillwater Public Use Zones Alternative B



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The adjacent agricultural fields would be restored to wetland-habitat to provide for environmental education and interpretation needs and enhance natural aesthetics. Boardwalks would be designed and constructed to allow access into the restored marsh. Agricultural fields may be maintained in adjacent areas (see Objective A.b.3), which would provide food for species such as white-faced ibis in the spring and summer and Canada geese in the fall and winter.

Parking areas would be improved to accommodate a number of busses and private vehicles simultaneously. The road to this complex would be designed for all-weather accessibility.

The environmental education program would be mobile and would include a traveling audio/visual program designed to interest a wide range of people. Off-site programs would include environmental education programs coordinated with other Federal, State, and local agencies, educational institutions, conservation organizations and private landowners and their representative organizations. On site, the environmental education program would provide all services from the visitor facility and adjacent marsh, few tours would be conducted in the historic marsh and these would be discouraged during the hunting season.

Monitoring Elements: Number, type, and location of facilities, and response by refuge visitors (e.g., number and type of visitor/group using each facility or location).

Objective C.b.2: Provide for the needs of students and teachers and make refuge and Service programs available to them.

Basis of Objective: Refuges are "learning laboratories" and Service programs are designed to show students and teachers the value of fish and wildlife resources.

Strategies to Achieve Objective: Staff will accommodate as many field trips and tours as possible. All other hands-on activities will take place at the visitor facility or the Stillwater Point observation area.

Monitoring Elements: Number of student and teacher groups per year, assessment of how well their needs and expectations were met.

Subgoal C.c: Provide opportunities for wildlife viewing and photography.

Basis of Subgoal: Providing opportunities for wildlife-oriented recreation is one of the purposes of Stillwater NWR. The Refuge System Administration Act identified wildlife viewing and photography as two of the six wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encourages the Service to provide opportunities for these uses. By providing the public with opportunities to view and photograph wildlife, plants, and wildlands, public awareness, understanding, and appreciation of the ecosystem functioning and the benefits of ecosystem conservation to fish, wildlife, and people will increase. This ultimately contributes to the mission of the Refuge System.

Objective C.c.1: Provide adequate viewing and photography opportunities through portions of the distinctive habitats of the refuge.

Basis of Objective: Achieving this objective would provide the public with the opportunity to view the relationships between resource management, wildlife and habitat, and people.

Strategies to Achieve Objective: An all-weather auto tour route would be developed throughout the refuge to guide visitors who prefer independent tours. The route would be paved to Stillwater Point where observation facilities, including a tower and boardwalk, would be developed. The route would continue, as an improved graveled road, to Hunter Road, to Nutgrass Road, to Navy Cabin Road and back to Hunter Road and Stillwater Point (Map 3.4).

A turnout with an accessible tower would be constructed at Doghead Pond. A second tower, complete with sanitation facility and shaded picnic tables, would be placed between the Goose and Nutgrass units. The interpretation of the tour route would be accomplished by directional signs with occasional information kiosks depicting natural features and wildlife. Opportunities for photography would exist as described in Alternative A.

A cooperative effort would be sought to provide camping opportunities during the nonhunting season through the Fallon Paiute-Shoshone Tribe, Bureau of Land Management, the city of Fallon, Churchill County, or any number of private organizations with land near or, adjacent to, Stillwater NWR.

Monitoring Elements: Number, type, and location of facilities constructed, and response of refuge visitors, e.g., number of visitors using each of the facilities (e.g., tour loop, Dry Lake wildlife-viewing trail, boardwalk) by season.

Subgoal C.d: Encourage and provide opportunities for research by other agencies (e.g., USGS, Agricultural Research Service), universities, and other institutions, especially as they relate to the management goals and objectives of Stillwater NWR.

Basis of Subgoal: As one of the purposes of Stillwater NWR, it is clear that an importance is placed on the need for providing opportunities for scientific research. Furthermore, it is the policy of the Service to encourage and support research and management studies that provide additional scientific data upon which to base decisions regarding management of units of the refuge system (4 RM 6). Research is key to sound resource management.

By providing research opportunities to universities, colleges, and other institutions, the education of students pursuing wildlife, archaeological, or other degrees is enhanced (Subgoal C.b), and the information they provide the refuge on wildlife-habitat relationships, the Cattail-eater culture, and other topics further facilitates environmental education and interpretation (Subgoal C.b) and wildlife conservation (Goals A and B). One of the objectives of supporting research in the Refuge System is to provide students and others with the opportunity to learn the principles of field research (4 RM 6).

Objective C.d.1: Foster relationships with government agencies, conservation groups, and institutions of higher education and communicate the most critical research needs of the refuge.

Basis of Objectives: Subgoal C.d addresses research by non-Service entities, such as other agencies, universities, colleges, and private institutions and organizations. Therefore, communicating this subgoal to these institutions, followed by ongoing coordination, would be important to its achievement.

Strategies to Achieve Objectives: Partnership opportunities would be actively sought, and unsolicited proposals for research in a variety of disciplines would considered, including wildlife, public use, and cultural resources. All reports, surveys, and scientific papers generated from such endeavors would be made available to refuge staff and cataloged for future needs.

Communicate to these institutions the priority information gaps that the Service is seeking to fill, such as the effects of human activities on wildlife and habitat on Stillwater NWR and other aspects of human and wildlife interactions; and habitat needs of species of special concern.

In addition to wildlife-oriented research, the Service may also permit the use of the refuge for other investigatory scientific purposes when such use is compatible with the purposes, goals, and objectives of the refuge. Priority would be given to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats in their natural diversity (4 RM 6).

Monitoring Elements: Number of research projects conducted, and number of participants for each endeavor.

Objective C.d.2: Facilities, equipment, and refuge lands would be maintained for potential use by researchers.

Basis of Objective: Providing facilities and equipment would facilitate research by non-Service institutions, in support of Subgoal C.d.

Strategies to Achieve Objective: Housing, equipment storage, and use of Service equipment would be provided at the discretion of the Refuge Manager, with priority given to research that furthers the goals and purposes of the refuge.

Monitoring Elements: Inventory of facilities available for researchers, listing of habitats used during research endeavors.

3.4.B.3 Fallon NWR

3.4.B.3.1 Boundaries

Boundary Alternative B would result in no changes to the existing boundaries of Fallon NWR (Map 3.3). The Bureau of Reclamation's primary withdrawal on lands within Fallon NWR would rescinded and replaced with a primary withdrawal by the Service. The ecological zones depicted in Map 3.3 show the general types of habitats that would be encompassed within this boundary alternative, as compared to their extent inside the existing boundaries. Ecological zones represented within Fallon NWR would primarily include The Carson River delta and the westernmost part of the sand dune system.

3.4.B.3.2 Management Program

The overall mission of Fallon NWR, under this alternative, would be to provide high-quality springtime habitat for waterfowl and other wetland birds and year-round sanctuary habitat to the extent that water is available to support these habitats on Fallon NWR wetlands. A secondary mission would be to provide opportunities for wildlife-dependent recreation during this season. Fallon NWR would be managed mostly under custodial maintenance, but, to the extent that drainwater and spill-water supplies allow, breeding habitat would be enhanced. Opportunities for waterfowl hunting would be provided on Fallon NWR when sufficient wetland habitat is available during the hunting season, and other uses including outdoor education and interpretation, wildlife observation, and wildlife photography would be facilitated.

3.4.B.3.2.1 Fish, Wildlife, and Vegetation Conservation

Guiding Principles

Management of fish, wildlife, and habitat would be guided by the following principles under this alternative.

Habitat Conditions. This alternative would focus on providing for the habitat needs of waterfowl and other wetland waterbirds during the breeding season, to the extent that spill-water and drainwater allow. An assumption under this alternative is that the biotic integrity and environmental health would be enhanced by providing high-quality habitat for breeding waterbirds. In so doing, all wetland wildlife species would be enhanced.

General Approach to Producing these Habitat Conditions. In developing annual water plans, the priority for water use would be to (1) provide high-quality nesting and brooding habitat, (2) provide high-quality feeding and resting habitat for waterfowl and other waterbirds during the spring migration, and (3) flush salts from wetlands.

Habitat management would focus on the management tools that would most effectively produce the habitat conditions to meet the particular needs of the species or species' group of interest. Water management and prescribed burning would be the primary management tools. Other tools would include controlled livestock grazing, mechanical treatments, and herbicides.

Compatibility. Under this alternative, compatibility determinations would evaluate the potential effects of public uses on waterbird nest success and production, waterbird behavior during the breeding season and during fall and spring migrations and winter. Given the purposes of Fallon NWR and other provisions of the executive order establishing the refuge (an emphasis on minimizing human disturbance), attempts would be made to proactively manage human disturbance in a way that avoids future compatibility problems, minimizing the extent to which changes have to be made to public use in response to problems.

Monitoring. Recognizing the importance of a sound monitoring program in a successful management program, increased emphasis would be placed on monitoring the status and trends of fish, wildlife, and plant populations and their habitat on each refuge (Refuge System Admin. Act, Sec. 5(3)(N)). Priority in the monitoring program would be given to tracking long-term wetland-habitat acreage, and long-term waterfowl and shorebird data sets.

Objectives and Strategies

Goal A: Provide high-quality sanctuary and breeding habitat for migratory birds.

Subgoal A.a: Provide wetland-habitat conditions that are generally beneficial to waterfowl and other wetland wildlife during spring and early summer during years when spill-water reaches the Carson River delta.

Objective A.a.1: Sustain a long-term average of 500 acres of wetland-habitat at the Carson River delta, which would be maintained through an average, spill-year spring peak acreage of about 2,000 acres, occurring on average one of every four years.

Basis of Objective: Maintaining a long-term average of 500 acres of wetland-habitat, at the Carson River delta portion of Fallon NWR, would contribute toward the target of 14,000 acres for Stillwater NWR and [former, under this alternative] Stillwater WMA, as this part of Fallon NWR is within the Stillwater WMA. The objective also generally contributes toward goals and objectives of the Intermountain West Joint Venture Plan (Intermountain West Joint Venture 1995), as well as the Nevada Partners in Flight Bird Conservation Plan (Partners in Flight), and U.S. Shorebird Conservation Plan, Intermountain West Region (Oring and Neel 2000).

Strategies to Achieve Objective: Wetland-habitat on Fallon NWR primarily results from precautionary releases and spills from Lahontan Reservoir, and this would continue under this alternative. Depending on spill intensity and duration, it would be possible to retain spill-water by closing structures in a recently restored levee separating the Carson River delta wetlands from the Carson Sink. To minimize damage to this levee, structures would remain open during high flows. However, as flow intensity decreased towards the end of the precautionary release or spill, structures would be closed to retain remaining water.

High evaporation rates occurring through summer months would rapidly deplete wetland-habitat acreage, but this strategy should provide up to 3,000 acres of spring migration and breeding habitat in spill years. Priorities for water management at Fallon NWR would be to (1) provide high-quality nesting and brooding habitat and (2) provide high-quality feeding and resting habitat for waterfowl and other waterbirds during the spring migration.

The Service would explore ways to increase the amount of water flowing into Fallon NWR. For example, input would be provided into the U.S. Army Corps of Engineer's study of the Fallon flood-abatement study and would seek to participate in the development of any subsequent plans based on the study.

Monitoring Elements: Use of remote sensing to monitor annual spring acreage of wetland habitat.

Objective A.a.2: On a broad scale, enhance and maintain nesting, brooding, feeding, and resting habitat.

Basis of Objectives: This objective would generally support Goal A of Fallon NWR, by maintaining quality breeding habitat in Carson River delta wet-meadow habitats, for a range of waterfowl and other waterbird species and would generally support habitat objectives outlined in the Intermountain West Joint Venture Plan. A numeric objective is not possible because the Service is not in control of timing, volume, duration, or frequency of water inflow.

Strategies to Achieve Objectives: The primary strategy would be to regulate water flows during spills and precautionary releases to minimize nest flooding to maintain brood habitat into early summer months. This would be accomplished through water management strategies identified in Objective A.a.2, but enhanced through elimination of livestock grazing for all but specific habitat management purposes. Unrestricted livestock grazing on the Carson River delta has reduced vegetative structural characteristics, reduced plant species diversity, and facilitated spread of invasive vegetative species (unpubl. data on file at Stillwater NWR), which decreases nest site suitability for waterfowl. However, livestock grazing could be used under management prescription, to produce quality foraging and breeding habitat for shorebirds, by opening up areas with dense residual vegetation and providing lightly vegetated uplands for shorebird breeding colony establishment. Livestock grazing would be one tool available for this purpose while controlled burning, mechanical treatment, herbicide application, and release of the salt cedar beetle would also be considered.

Monitoring Elements: Extent and relative percentage of wet meadow habitat within the Carson River delta (aerial photography/satellite imagery). Additionally, livestock grazing exclosures would continue to be monitored to determine changes in vegetative structure, diversity, and invasive species encroachment.

Objective A.a.3: Provide a range of water conditions throughout the Carson River delta to the Carson Sink, from freshwater areas (less than 1,000 milligrams per liter (mg/L) total dissolved solids to areas of highly saline alkali playa in the Carson Sink (e.g., up to 50,000 mg/L or more)).

Basis of Objectives: Different plant and animal communities tend to form within a specific range of water conditions. Providing a wide range of these conditions would maximize biological diversity and species richness.

Strategies to Achieve Objectives: Because methods to store water distributed to Fallon NWR during precautionary releases and spills are not available, water conditions would primarily be controlled through the structure releasing water from the Carson River delta to the Carson Sink. Water would be allowed to flow to the Carson Sink unregulated during high intensity portions of the precautionary release (when Carson River flows exceed 800 cfs) which would flush surface salts out to the Carson Sink. Salt removal would tend to freshen the system, which would allow plant species with low salinity tolerance to germinate in the wetlands. By closing the outflow-structure when flow intensity decreases, would retain remaining water and increase salinity as evapotranspiration began to remove water during early summer months. Therefore, salinity ranges would be regulated by a combination of flow intensity during precautionary releases and spills (with salinity generally increasing with distance from the Carson River), and season as remaining water evaporates during summer.

Monitoring Elements: TDS monitoring of Carson River inflows to the Carson River delta and periodic monitoring at different points along the delta to the Carson Sink when Fallon NWR is hydrated.

Objective A.a.4: Minimize the amount of contaminants entering the Carson River delta and reduce mercury levels in wetland sediments to less than 1.5 parts ppm.

Basis of Objectives: Contaminants have the potential to impair the Service's ability to achieve refuge goals and purposes.

Strategies to Achieve Objectives: Strategies to achieve this objective would be similar to those described for Stillwater NWR. Through coordination with TCID, steps would be taken to ensure that water entering the refuge does not contain herbicides and other pesticides detrimental to aquatic life and other wildlife. Through cooperation with the Environmental Protection Agency (EPA) and the Ecological Services office of the Fish and Wildlife Service in Reno, the most appropriate means to reduce mercury concentrations and avoid any increased distribution of mercury contamination would be determined. With the recognition that few options exist for managing water at Fallon NWR, the Service would work with Bureau of Reclamation, TCID, and EPA to identify and explore options of spilling water from Lahontan Reservoir in a way that would minimize transport of mercury from Lahontan Reservoir.

Monitoring Elements: Coordinate with the Ecological Service office of the Fish and Wildlife Service to periodically assess mercury loading at designated sites.

Subgoal A.b: In the wetland-habitat that is available during the breeding season, maximize nesting success and production of waterfowl and other waterbirds.

Objective A.b.1: Within wet meadow and adjacent upland habitats, enhance and maintain dense nesting cover for mallards, green-winged teal, gadwall, and other waterfowl in areas close to brooding habitat.

Basis of Objective: Waterfowl nesting studies have repeatedly shown that higher nest success in dabbling ducks is associated with dense nesting cover.

Strategies to Achieve Objectives: In years where precautionary spill-water reaches the Carson River delta, a mix of dry and hydrated wet meadow sites would be maintained primarily through water level control described in Objective A.a.1. Other methods to increase quality of dense nesting cover for waterfowl include prescribed burning and exclusion of livestock grazing, except on a limited basis to reduce residual plant material (see objective A.a.1). Cattle grazing on Fallonr NWR would be reduced from current levels to desired levels identified in this alternative over a period of three years (a maximum of 500-1,000 AUMs for both Fallon NWR and Stillwater NWR).

Monitoring Elements: Waterfowl brood counts would be used as an index of habitat availability.

Objective A.b.2: Provide high-quality nesting and brood-rearing habitat for shorebirds, especially American avocets (targeting 1,500 pairs, combined with Stillwater NWR, in spill years), and snowy plovers (to contribute significantly to the State-wide target of 900 adults), targets based on the Nevada Partners in Flight Plan.

Basis of Objectives: The Carson River delta and other wetlands in the Lahontan Valley are components of the Western Hemispheric Shorebird Reserve Network, stressing the importance of contributing to the international effort to conserve shorebird populations. The Lahontan Valley wetlands provide important breeding habitat for American avocets and snowy plovers (a species of special concern), which are key species identified in the Nevada Partners in Flight Plan. Providing high-quality habitat for shorebirds would also contribute toward accomplishment of goals and objectives in the U.S. Shorebird Management Plan.

Strategies to Achieve Objective: To the extent that spill-water reaches the Carson River delta and water management strategies prescribed under Objective A.a.1 were implemented, American avocets and other shorebirds would be provided shallowly-flooded wet meadows throughout the Carson River delta, and snowy plovers would be provided flooded alkaline playa in the Carson Sink. This would contribute to the Nevada Partners in Flight Plan during spill years by providing at least one flooded alkaline playa. The nesting habitat needs of snowy plovers would be studied, and periodic censuses would be coordinated with other agencies and groups involved in snowy plover recovery efforts. Predation of chicks and eggs would be monitored, and remedial action would be taken if predation levels exceed 50 percent (Nevada Partners in Flight Plan). Remediation strategies are defined in objective A.b.3.

Monitoring Elements: Coordinate a shorebird breeding-population survey with other agencies (Nevada Partners in Flight Plan). Annually accomplish snowy plover and American avocet breeding pair survey on Fallon NWR.

Objective A.b.3: Minimize the effects of nest depredation on nesting success of waterfowl, shorebirds, and other waterbirds.

Basis of Objectives: Upland nesting waterfowl and shorebirds, are a primary management focus under this alternative. Apparent increases in natural predator populations (primarily common ravens) may have surpassed levels commonly associated with the Carson River delta.

Strategies to Achieve Objectives: A predator control program would be designed and implemented to enhance nest success and production of waterfowl, shorebirds, and other waterbirds. The main target species would be common ravens, although other nest predators could be included. Methods could include trapping, shooting, and in extreme cases, poisoning.

Monitoring Elements: In years when the Carson River delta wetlands are flooded, waterfowl breeding pair numbers would be compared with waterfowl brood counts to estimate relative nest success. Common ravens would be censused to determine trends in abundance.

Subgoal A.d: Ensure that recreational and other uses do not adversely impact nesting waterbirds, and that opportunities for recreational and other uses are managed to minimize impacts to waterbirds and other wildlife during the remainder of the year.

Objective A.c.1: Minimize the adverse effects of disturbance to waterbirds during the nesting and brooding seasons, while still providing opportunities for environmental education, wildlife observation, and other wildlife-dependent recreational uses.

Basis of Objectives: Many waterbird species are particularly sensitive to disturbance during the breeding season and desire nest sites that are remote and relatively disturbance free. Human activities (whether public use, researcher, or staff related) tend to compound natural levels of disturbance to which these species have adapted.

Strategies to Achieve Objectives: Waterbird disturbance would be minimized during the breeding season by limiting visitor use to roads and established parking areas. Research and monitoring activities would be limited to those activities essential to achieving objectives for Fallon NWR, for example, data collection to determine whether objectives under Goal A are being met. Other activities conducted by refuge staff would include prescribed habitat management procedures to achieve habitat objectives and operation of the water control structure to facilitate water distribution between the Carson River delta and the Carson Sink. Habitat Management prescriptions would only be implemented after the breeding season.

Monitoring Elements: Public use monitoring, law enforcement to ensure compliance.

Objective A.c.2: Provide secure feeding and resting habitat for waterfowl and other waterbirds during the hunting season when wetland-habitat is available during the hunting season.

Basis of Objective: The purposes of the refuge call for Fallon NWR to be managed in part as a sanctuary. Therefore, when sufficient water exists in Fallon NWR to provide hunting opportunities, part of the refuge must be closed to hunting to maintain consistency with refuge purposes.

Strategies to Achieve Objective: Waterfowl hunting would be allowed on up to 40% of Fallon NWR during the waterfowl hunting season with the remaining 60% to be retained as sanctuary for fall migratory waterbirds. If less than 500 acres of wetland-habitat is available during the hunting season, the refuge would be closed to hunting.

Monitoring Elements: Proportion of wetland-habitat that is in the hunted and nonhunted areas.

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Goal B: Restore and maintain natural biological diversity.

Under Alternative B, it would be assumed that the achievement of subgoals and objectives under Goal A would generally address the goal to restore and maintain natural biological diversity in the Carson River delta wetlands. The following objective would address the biological diversity in the sand dune area, with an emphasis on native species richness.

Objective B.1: Restore, approximate, and maintain the natural distribution and abundance of upland plant communities and habitat types that would exist naturally, according to location, throughout upland portions of the refuge.

Basis of Objectives: Sand dunes located on Fallon NWR add to the overall natural biological diversity of the refuge and represent a unique component of the Great Basin ecosystem. This sand dune system is currently subject to invasive species encroachment (primarily saltcedar), livestock grazing, and off-road vehicle use.
Strategies to Achieve Objectives: Integrity of the sand dune system would primarily be accomplished through a combination of restricting access and controlling invasive species encroachment. off-road-vehicle use would be eliminated through periodic law enforcement patrols and public use impacts would be minimized to the extent that strategies outlined under Objective A.c.1 were achieved. Invasive species encroachment would be controlled to the extent that funding could be secured to eliminate existing saltcedar stands. Periodic monitoring of invasive species would be used to ensure that other invasive species did not become established. Additionally, a study design would be considered to determine the importance of Carson River sand deposition as a process contributing to regeneration and movement of the sand dune system. As part of this effort, other agencies such as the U.S. Geological Survey would be considered as cooperators.
Monitoring Elements: A combination of public use monitoring strategies, remote sensing to identify saltcedar distribution, and periodic cruising to determine whether other invasive species have become established would be used. A study to determine sand deposition rates and related alluvial process would be conducted to the extent that funding and outside agency expertise could be obtained.

3.4.B.3.2.2 Public-Use Management

Guiding Principles

Guiding principles would be similar to those Stillwater NWR under this Alternative, except that much more emphasis would be placed on minimizing impacts of people on Fallon NWR, given the purposes of the refuge.

Objectives and Strategies

Goal C: Provide opportunities for environmental education and wildlife-dependent recreation that are compatible with refuge purposes and Refuge System mission.

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Subgoal C.a: Provide opportunities for high-quality hunting experiences.

Objective C.a.1: Provide hunting opportunities when sufficient water is available during fall at Fallon NWR, whereby hunters would have a reasonable chance of success.

Basis of Objective: Hunting has been identified as a primary, wildlife-dependent recreational activity under the Refuge System Administration Act, and while the Fallon NWR establishing authority states that this area will be maintained as a sanctuary and breeding habitat for migratory birds, up to 40% of the area can be opened to waterfowl hunting during the established waterfowl hunting season.

Strategies to Achieve Objective: In years when adequate wetland-habitat exist during fall (at least 500 acres), up to 40% of Fallon NWR would be opened to waterfowl hunting. The area available for hunting generally encompasses the southwest corner of the refuge (Map 3.4) and consists of all lands located south of the levee separating the Carson River delta wetlands from the Carson Sink. All lands north of this levee would be maintained as sanctuary in all years. All regulations specific to Stillwater NWR (Objective C.a.1) would also apply to Fallon NWR.

Monitoring Elements: Numbers of hunters, feedback on the quality of the hunting experience.

Objective C.a.2: Ensure that hunting experiences are safe.

Basis of Objective: Beyond being a vital consideration in the management of any public use, the Refuge System Administration Act requires that wildlife-dependent recreation be allowed only to the extent they is consistent with public safety.

Strategies to Achieve Objective: If hunter densities begin to approach unsafe levels, hunter density thresholds may be established. Otherwise, such thresholds would not be established.

Monitoring Elements: Number and types of reported and observed injuries per hunting season, observations by staff of unsafe practices and law enforcement violations.

Subgoal C.b: Provide opportunities for an experience in environmental education that generally meet the needs of users.

Objective C.b.1: Provide opportunities and resources for environmental study at Fallon NWR.

Basis of Objective: Opportunities to learn more about sand dune development, functioning of Great Basin riverine systems, and the culture of the northern Paiute people are available at Fallon NWR. This allows for an educational opportunity that encompasses unique components of the Great Basin ecosystem, some of which are not found on Stillwater NWR.

Strategies to Achieve Objective: Considering that no development of environmental education facilities would be constructed at Fallon NWR, the primary strategy to achieve this objective would be to inform visiting educators that this opportunity exists and to make arrangements when a tour group wishes to observe components unique to Fallon NWR. Because no effort would be made to improve access to this area, visits would be dependent on condition of roads and availability of refuge personnel to lead tour groups. To the extent that tour groups desired this educational opportunity, facilities would be considered in future public use step down management plans.

Monitoring Elements: Number of groups receiving tours to Fallon NWR.

Subgoal C.c: Provide opportunities for wildlife viewing and photography.

Objective C.c.1: Provide viewing and photography opportunities through portions of the distinctive habitats of Fallon NWR.

Basis of Objective: The Refuge System Administration Act specified that wildlife viewing and photography as wildlife-dependent recreational uses are to be facilitated in the Refuge System, and the Act strongly encourages the Service to provide opportunities for these uses. By providing the public with opportunities to view and photograph wildlife, plants, and wildlands, public awareness, understanding, and appreciation of ecosystem function and the benefits of ecosystem conservation to fish, wildlife, and people will increase.

Strategies to Achieve Objective: Similar to Objective C.b, no additional facilities or roads would be developed at Fallon NWR to fulfill this objective. However, Fallon NWR would provide a unique opportunity for individuals desiring a more primitive wildlife observation and photography experience in a setting with few other individuals present. The road currently accessing Fallon NWR would remain open but would be listed as a primitive road in refuge maps. As with Stillwater NWR, visitors would be restricted to their vehicles except at designated pullouts and a primitive parking area located at Battleground Point. No additional construction would be undertaken. However, designated areas would be identified on the refuge brochure. Parameters associated with wildlife education and photography for Stillwater NWR (Objective C.c.1) would apply to Fallon NWR.

Monitoring Elements: Monitoring elements for this objective will primarily be provided to the extent that feedback is received from refuge visitors. Visitation is not anticipated to be at a level which would justify public use monitoring at Fallon NWR. If public feedback suggests that monitoring of Fallon NWR is warranted, monitoring procedures will be incorporated into the Public Use monitoring program.

Subgoal C.d: Encourage and provide opportunities for research by other agencies (e.g., U.S. Geological Survey, Agricultural Research Service), universities, and other institutions, especially as they relate to the management goals and objectives of Fallon NWR.

Objective C.d.1: Foster relationships with government agencies, conservation groups, and institutions of higher education by providing research opportunities and by developing cooperative working programs.

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Basis of Objective: While not a stated purpose of Fallon NWR, outside research would be a key element to understanding ecological processes such as sand dune formation and movement; contaminants impacts on plants, fish and wildlife; and cultural resource implications on this refuge.
Strategies to Achieve Objective: At present, this objective would be accomplished through coordination with research related agencies for identified research needs suggested above. To the extent that these information needs were filled, other proposals submitted by outside agencies would be considered, with priority given to proposals which most closely reflect management objectives outlined under this alternative and which contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats in their natural diversity (4 RM 6).
Monitoring Elements: Ongoing and completed research projects would be counted along with the number of participating agencies within each project.

3.4.B.4 Anaho Island NWR

Guiding principles, goals, objectives, and strategies would be the same as under Alternative A.

3.4.B.5 Other Program Areas

All of the "other program areas" would be managed similarly as they would be under Alternative A, except the commercial use program, monitoring program, law enforcement, and administration. Under Alternative B, there would not be a commercial use program, as livestock grazing and muskrat trapping would be managed exclusively as habitat management tools, and not to provide commercial revenue. Adjustments to monitoring, law enforcement, and administration are presented below.

3.4.B.5.1 Other Public Uses

Guiding Principles

Nonwildlife-dependent public uses would not be promoted or encouraged on Stillwater NWR, but may be permitted if they are found to be appropriate and compatible with refuge purposes and the Refuge System mission. On Fallon NWR, these other uses would not be permitted until the refuge is specifically open to them.

Strategies

A cooperative effort would be sought to provide camping opportunities during the nonhunting season through the Fallon Paiute-Shoshone Tribe, Bureau of Land Management, the City Fallon, Churchill County, or private organizations with land near or adjacent to Stillwater NWR.

3.4.B.5.2 Monitoring and Research Program

The biological monitoring program would be similar to that of Alternative A. The public-use monitoring program (explained in Alternative A, Section 3.4.A.4.8) would be modified to better gauge whether (1) high-quality viewing opportunities are being provided, (2) safe, equitable, and accessible opportunities are provided, (3) conflicts between uses are detected and eliminated, and (4) the message of stewardship, conservation, and ethics is being received by the public.

3.4.B.5.3 Facility Maintenance and Safety

Although mosquitos would not be actively controlled on Stillwater NWR or Fallon NWR, a contingency plan would be developed in conjunction with the Churchill County Mosquito Abatement District to identify actions to take in the event of an encephalitis outbreak (M. Wargo, Churchill County Mosquito Abatement District, personal communication, 1998). The Churchill County Mosquito Abatement District was formed in 1985 to provide public health protection to the citizens and visitors of Churchill County from the annoyance and potential disease transmitting mosquitoes occurring in the county. The mosquito abatement district maintains several flocks of sentinel chickens in Churchill County to monitor the incidence of encephalitis in the county. Encephalitis is detected each year in the sentinel chickens, but cases of encephalitis in humans are rare in the county. The Churchill County Mosquito Abatement District's intent is to use those techniques that will cause the least adverse impact to the environment while providing the highest level of mosquito control. (Churchill County Mosquito Abatement District, written communication, Sept. 1, 1995.)

3.4.B.5.4 Law Enforcement

Alternative B would expand on the law enforcement program outlined under Alternative A, including the addition of a full time law enforcement officer. This alternative would highlight the importance of refuge law enforcement while taking some of the burden off collateral duty refuge officers who typically spend most of their time on tasks not related to law enforcement. Law enforcement personnel would attend specific training in cultural resource protection, identification, the Archaeological Resources Protection Act, and Tribal consultations.

Under this alternative, emphasis of the law enforcement program would be on an education program in which refuge officers could adopt a proactive stance of working with refuge visitors and user groups to provide a better understanding of the laws and regulations specific to Stillwater NWR, Fallon NWR, and the Refuge System in general. The program would focus on workshop presentations consisting of waterfowl identification and hunting safety, while identifying key laws and regulations related to the ethical hunting of game species. While these workshops would be open to the general public, younger hunters of late grade school and junior high school age would be specifically targeted to help ensure that future generations of hunters would maintain safe and ethical standards throughout a lifetime of hunting.

Additionally, at least two law enforcement kiosks would be established, one at the intersection of West County Road and Indian Lakes Road and the other at the intersection of Stillwater Road and Hunter Road. A third kiosk could be located at the southern boundary of Fallon NWR. The kiosks would consist of an abbreviated list of refuge specific rules and regulations in large print, and refuge flyers which include Federal and State hunting regulations. Copies of hunting regulations would be provided to hunters in an effort to help to eliminate confusion of hunters, and to maximize safe, ethical, and enjoyable experiences.

Efforts would be increased to adequately post road closures and to ensure that barriers are sufficient to deter travel through or around barriers. Signing efforts would be increased to provide guidance on refuge traffic rules and regulations to help promote vehicle safety. Additional parking areas would be provided to allow sufficient parking space for refuge visitors and off road vehicle violations would be strictly enforced.

Other law enforcement issues being considered include a self check system where refuge visitors would obtain a free daily use permit (located at the law enforcement kiosks) which would provide the refuge public use program with valuable information, while ensuring that refuge visitors obtain a copy of refuge rules and regulations prior to their visit. Another possibility would be to impose a shotgun shell limit for refuge waterfowl hunters to discourage shooting at waterfowl beyond the capabilities of their shotgun. A shell limit would encourage hunters to select their targets carefully, this would ultimately reduce crippling loss and provide a high-quality hunting experience for all refuge visitors.

3.4.B.5.5 Budget and Administration

Several projects have been identified for implementation under Alternative B. The largest would be a refuge administrative complex which would include a visitor facility and maintenance shop (an estimated $2,441,500 under this alternative). Other projects include development of additional public use facilities such as auto tour routes, nature trails, observation areas and interpretive signs (an estimated $4,609,800 under this alternative). Total capital costs of the water-rights acquisition program are presented in the WRAP EIS (USFWS 1996a). Funding for these projects varies greatly depending on Congressional appropriations and the refuge's ability to obtain special project funds from sources such as grants, and Transportation Equity Act funds and, therefore, predicting the actual "nonsalary" funding is difficult.

The projected annual costs of managing the Stillwater NWR Complex under Alternative B would be an estimated $3.1 to 3.4 million/year upon completion of the water-rights acquisition program. Projected annual expenditures include salaries; refuge operation and maintenance costs; water delivery and operation and maintenance charges; refuge revenue sharing payments; and water-rights leasing costs. Annual expenditures related to the water-rights acquisition program were discussed in Section 3.3.1.1., Features and Assumptions Common to all Alternatives. Refuge salaries and operations and maintenance costs would be an estimated $1.55 million/year under this alternative.

Refuge staff under Alternative B would be similar to Alternative A except one additional position would be added: a park ranger (GS-9 law enforcement), bringing the total number of permanent full-time positions to fourteen.

3.4.C.1 Broad Management Direction

3.4.C.1.1 Refuge Purposes

The purposes of Stillwater NWR and Anaho Island NWR would be the same as under Alternative B. Fallon NWR would not exist under Alternative C, but the purpose of Fallon NWR would be added to the purposes of Stillwater NWR for the management of a "Fallon Unit." Also, other provisions of Executive Order 5606 would comprise management standards for the Fallon Unit.

3.4.C.1.2 Refuge and Program Goals

Refuge goals step down directly from refuge purposes, as influenced by applicable laws, executive orders, and Service policy. For each refuge, they are listed in priority order.

Stillwater NWR Goals

A. Conserve and manage fish, wildlife, and their habitat to restore and maintain natural biological diversity.

B. Contribute toward fulfilling obligations of international treaties and other international agreements with respect to fish and wildlife.

C. Provide opportunities for scientific research, environmental education, and wildlife-dependent recreation that are compatible with refuge purposes.

Basis of Goals: These goals stem directly from the purposes set forth in Public Law 101-618 (206(b)(2). Restoration of natural biodiversity is one of several viable ways to conserve and manage the fish and wildlife of Stillwater NWR. The focus on natural biodiversity is therefore consistent with the first and second purposes of the refuge, as well as the third purpose (reflected in Goal B), given the common theme in international treaties to restore natural habitats and ecosystems. This focus is also consistent with the Refuge System Improvement Act's directives to maintain biotic integrity and diversity, and environmental health on refuges. Goal C mirrors the third refuge purposes with the addition of a compatibility phrase to ensure consistency with the Refuge System Improvement Act.

Anaho Island NWR Goals

A. Protect and perpetuate colonial-nesting birds and other migratory birds.

B. Restore and maintain natural biological diversity.

Basis of Goals: These goals were derived from the purposes set forth in Public Law 101-618 210(b)(2) and Executive Order 1819 that originally established the refuge. The secondary goal to restore and maintain natural biodiversity supports the overall mission of the Refuge System and the Refuge System Improvement Act's directive to maintain biological integrity and diversity, and environmental health on refuges.

3.4.C ALTERNATIVE C

This is the Service's preferred alternative. It would emphasize restoring the diversity of native wildlife and habitats associated with a naturally functioning Great Basin wetland ecosystem. The ecological processes that naturally shaped and maintained this ecosystem would be mimicked, and this overall approach would be adjusted to ensure benefits to native wildlife. Breeding habitat for wetland birds would be emphasized, but considerable wetland-habitat would be made available for fall and winter waterfowl habitat and for waterfowl hunting. Declining water levels during the late summer and fall would greatly benefit fall-migrating shorebirds. Monitoring of species of special interest, especially those identified as priority species in international bird conservation plans, would provide a check on management to ensure that the needs of these and other species are being adequately met.

The Alternative C boundary-revision would most significantly add am 18-mile stretch of river-riparian habitat along the lower Carson River and a 21-mile long dune complex to the Refuge System. The contiguous portion of Fallon NWR, encompassing much of the Carson River delta, would be incorporated into Stillwater NWR, as would a vast area of salt desert shrub that is now in the Stillwater WMA.

Under this alternative, opportunities for wildlife-dependent recreation would be enhanced considerably over existing conditions. Waterfowl hunting would remain an integral part of the program, with uncrowded hunting conditions and a variety of opportunities being promoted. The environmental education program would be enhanced and several areas for wildlife observation and environmental interpretation would be developed. Under this alternative, the Service would strive to balance opportunities for wildlife-dependent recreation. Cultural resource management would become a proactive program under this alternative.

Anaho Island NWR would be managed much as it has in the past, with an emphasis on protecting and monitoring the nesting colony of American white pelicans and other colonial-nesting birds that use the island.

Some of the major headings under Alternative C are as follows:

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In addition to refuge goals, which identify what was hoped to be accomplished by establishing the refuges, many refuges have other programs that are peripheral to the core programs (i.e., wildlife and wildlife-dependent recreation). Many of these are integrally related to more parts of the core programs. Goals were developed for two of these programs. Although they do not directly relate to the purposes for which the refuges were established, they are important programs that can contribute indirectly toward the achievement of refuge goals in a number of ways.

Outreach Program Goal

Enhance public awareness of the Service and the Service's mission and role in wildlife conservation.

> ***Basis of Goal:*** This goal supports the Service's nationwide communication strategy called the *100 on 100 Outreach Campaign*, which targets 100 percent of Americans being aware of the Refuge System by its 100th anniversary. This goal reaches beyond the environmental education and interpretation program addressed in Stillwater NWR goals toward educating the public about the Refuge System and the Service as a whole, although it is integrally related to this refuge-specific program.

Cultural Resource Management Program Goal

Manage cultural resources for the educational, scientific, and cultural benefit of present and future Americans.

> ***Basis of Goal:*** The culture of the original human inhabitants of Stillwater Marsh and the cultural resources left behind by these people are an important part of the marsh's history. The archaeology of Stillwater Marsh, which has rewritten the standard interpretation of Great Basin prehistory, has attracted considerable interest. Cultural resources of Stillwater Marsh are some of the most important in Nevada.

Other Program Areas

Several other programs would be maintained or enhanced under Alternative C. As yet, goals have not been established for these programs. The programs identified below are described in more detail later:

- Partnerships and Other Cooperative Efforts
- Water-Rights Acquisition and Land Disposal Program
- Fire Management
- Other Public Uses
- Monitoring and Research Program
- Facilities Maintenance and Safety
- Law Enforcement
- Administration

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3.4.C.2 Stillwater NWR

3.4.C.2.1 Boundary

This is the Service's proposed boundary revision. Under this alternative, the boundary of Stillwater NWR would be revised to encompass much of Stillwater WMA and Fallon NWR, the management and operation of the remaining portions of each would be conveyed to the jurisdiction of the Bureau of Reclamation[1] or public land status (Map 3.5). The revised boundary would also include six sections south of Stillwater WMA along the Carson River and 26 sections north of Stillwater NWR following the chain of sand dunes. This would be done in order to restore and maintain the natural biological diversity associated with the lower Carson River and its delta, the sand dune complex along the southern "shore" of the Carson Sink, and salt desert shrub uplands representative of the Carson Desert. Map 3.5 depicts the ecological zones that would be included within Alternative C's boundary of Stillwater NWR, as compared to the ecological zones that now exist within Stillwater NWR, Stillwater WMA, and Fallon NWR. All ecological zones would continue to be represented under this alternative.

Upon completion of all required environmental analyses, boundary revisions could be pursued administratively under the Fish and Wildlife Act of 1956, as amended, or Congress could revise the boundary legislatively. Congressional approval would be required to dispose of any lands now within the Fallon NWR from the Refuge System.

As part of this alternative boundary revision, it is proposed that the name and designation of Fallon NWR be rescinded, and that a portion of the former Fallon NWR (approximately 10,818 acres of Federal land) be added to Stillwater NWR. The Bureau of Reclamation's primary withdrawal on these lands would have to be rescinded and replaced with a primary withdrawal by the Service. The primary withdrawal on the remaining portion of Fallon NWR (those not added to Stillwater NWR, totaling about 7,030 acres located in T22N, R30E, alternating sections 2, 4, 6, 8, 10, 14, 16, 18, 20, and 26) would, under this alternative continue to be held by the Bureau of Reclamation for Newlands Irrigation Project purposes or returned to management by the Bureau of Land Management as public land.

Under this alternative, it is assumed that the portion of Fallon NWR proposed for disposal from the National Wildlife Refuge System contributes minimally toward its original purposes. These alternating sections of land are located in the Carson Sink and rarely contain enough water to provide wetland-habitat. The lands comprise less than 5 percent of the Carson Sink. Most of the remaining portion of the Carson Sink consists of public lands withdrawn by the Bureau of Reclamation for Newlands Irrigation Project drainage purposes. Disposal of Fallon NWR lands from the Refuge System would require Congressional approval.

Upon the expiration of the 1948 Tripartite Agreement extension, management and operation of the Federal lands within Stillwater WMA not added to Stillwater NWR will be returned to the

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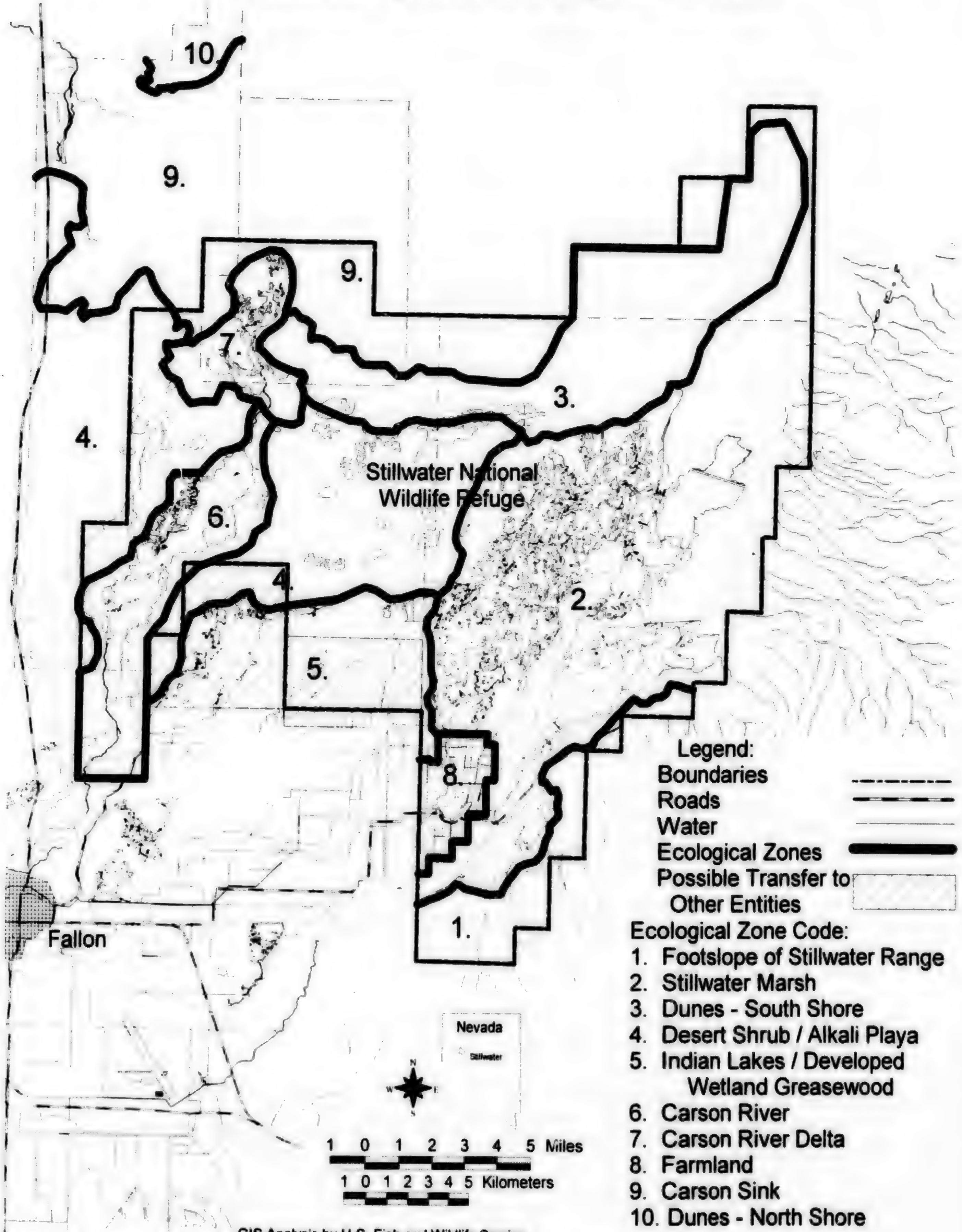
[1] Bureau of Reclamation currently holds the primary withdrawal on Federal lands within Stillwater WMA and Fallon NWR.

Map 3.5 Stillwater Alternative C Boundary and Ecological Zones



GIS Analysis by U.S. Fish and Wildlife Service

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jurisdiction of the Bureau of Reclamation or public land status. Possible exceptions include the Indian Lakes area and certain lands north of the Fallon Paiute-Shoshone Indian Reservation. It is possible that the Indian Lakes area will be transferred to Churchill County and subsequently to the City of Fallon, as authorized under subsection 206(g) of Public Law 101-618. The eight southernmost sections within this alternative's boundary revision, just north of the Fallon Paiute-Shoshone Indian Reservation is proposed for addition to the Stillwater NWR to the extent that it is not added to the reservation (Map 3.5). The Fallon Paiute-Shoshone Tribe has been exploring options for expanding the boundary of the reservation into this general area.

The existing 1987 MOU with the U.S. Navy would be revised to reflect that this northward extension of the boundary toward the Bravo-20 Bombing Range would not affect the 3,000-foot ceiling. It would remain at the northern limit of the existing, Public Law 101-618 boundary of Stillwater NWR. The designations of Stillwater WMA and Fallon NWR would no longer exist under this alternative. The boundary of Anaho Island NWR would remain unchanged.

3.4.C.2.2 Management Program

Goals, subgoals, and objectives of Stillwater NWR are long-term; some could be achieved and maintained within a few years, whereas others may require several decades to accomplish. One driving force behind many of the wetland-related subgoals and objectives is the completion of the water-rights acquisition program, which, although it could possibly be completed within 15 years, could take 20 years or more to complete. Furthermore, restoration of the composition, structure, and functioning of riparian communities would take longer than 15 years. Goals and objectives are presented in the long-term because of the difficulty in estimating what can be accomplished within the 15-year planning horizon, and, more important, because long-term, eventual goals and objectives are needed to adequately show the direction of management. Fifteen-year objectives must be developed within the context of long-term goals and objectives. Chapter 4 identifies the estimated progress that would take place toward meeting long-term goals and objectives. The CCP, when completed, would identify 15-year objectives, as well as long-term goals and objectives.

This section is divided into two main parts: (1) Native Fish, Wildlife, and Vegetation Conservation; and (2) Public Use Management. For each of these parts, guiding principles, the refuge goals (identified earlier), subgoals, objectives, and strategies are outlined. A summary outline of goals, subgoals, and objectives is provided on the next page for reference purposes.

3.4.C.2.2.1 Native Fish, Wildlife, and Vegetation Conservation

Guiding Principles

The management of fish, wildlife, and vegetation on Stillwater NWR, under this alternative, would be guided by the following principles.

Habitat Conditions. This alternative would focus on approximating natural habitat conditions as the primary means to conserve and manage the refuge's wildlife, restore its natural biological diversity, and fulfill international treaty obligations with respect to fish and wildlife. The needs

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Topics of Alternative C's Goals, Subgoals, and Objectives for Stillwater NWR

— A Hierarchical Outline —

Goals (capital letters)
  Subgoals (lower case letters)
    Objectives (numbers and others)

- **A:** natural biological diversity
  - **A.a:** diversity of animals
    - **A.a.1:** native animal species and guilds
    - **A.a.2:** population levels animal species
    - **A.a.3:** abundance of nonnative animals
  - **A.b:** diversity within and among plant communities
    - **A.b.1:** native plant species and communities
    - **A.b.2:** distribution and mix of plant communities
      - **A.b.2(a):** acreage target for wetland-habitat
      - **A.b.2(b):** Stillwater Marsh habitats
      - **A.b.2(c):** Carson River and Stillwater Slough
      - **A.b.2(d):** Carson River delta habitats
      - **A.b.2(e):** Upland habitats
    - **A.b.3:** within-community species composition
      - **A.b.3(a):** composition of major species
      - **A.b.3(b):** nonnative plant species establishment
      - **A.b.3(c):** spread of nonnative plant species
    - **A.b.4:** vegetative structure
      - **A.b.4(a):** Stillwater Marsh/Carson River delta
      - **A.b.4(b):** Carson River and Stillwater Slough
      - **A.b.4(c):** Uplands
    - **A.b.5:** water chemistry and contaminants
      - **A.b.5(a):** levels of total dissolved solids
      - **A.b.5(b):** contaminants entering the wetlands
      - **A.b.5(c):** mercury loading
  - **A.c:** rates, levels, and distribution of biotic processes
    - **A.c.1:** unnaturally high rates of grazing
    - **A.c.2:** natural rates of herbivory
    - **A.c.3:** unnaturally high nest-depredation rates
    - **A.c.4:** human disturbance
  - **A.d:** inventories, management studies, and research

Goals
  Subgoals
    Objectives

- **B:** international treaty obligations and agreements
  - **B.a:** pollution and detrimental alteration of habitats
  - **B.b:** natural habitats and ecosystems
  - **B.c:** compatibility of public uses
  - **B.d:** needs of migrating and breeding shorebirds
    - **B.d.1:** nesting and brood-rearing habitat
    - **B.d.2:** spring and fall migration habitat
  - **B.e:** needs of breeding and migrating waterbirds
    - **B.e.1:** nesting and brood-rearing habitat
    - **B.e.2:** fall and winter habitat for waterfowl
    - **B.e.3:** minimization of botulism
    - **B.e.4:** habitat for other waterbirds
  - **B.f:** needs of neotropical migratory birds
    - **B.f.1:** riparian birds
    - **B.f.2:** salt desert shrub birds
  - **B.g:** needs of species of special concern
    - **B.g.1:** habitat for bald eagles
    - **B.g.2:** habitat for snowy plovers
    - **B.g.3:** habitat for species in riparian areas
- **C:** opportunities for wildlife-dependent public uses
  - **C.a:** hunting
    - **C.a.1:** success in uncrowded conditions
    - **C.a.2:** safe experiences
  - **C.b:** environmental education and interpretation
    - **C.b.1:** adequate facilities
    - **C.b.2:** needs of teachers and students
    - **C.b.3:** interpret natural and cultural of area
  - **C.c:** wildlife observation and photography
    - **C.c.1:** high-quality wildlife viewing opportunities
    - **C.c.2:** high-quality wildlife photography
  - **C.d:** scientific research
    - **C.d.1:** relationship with research institutions
    - **C.d.2:** provide facilities

This outline of topics lists the main components of each goal and the relationships among goals, subgoals, and objectives. The main components of biological diversity, under Goal A, are wildlife diversity (Subgoal A.a), vegetative diversity (Subgoal A.b), and diversity of biotic processes (Subgoal A.c). The outline illustrates the attributes of vegetative diversity: richness (A.b.1), among-community composition and patterns (A.b.2), within-community composition (A.b.3), and vegetative structure (A.b.4). Subgoals under Goal B depict the main elements of international treaties (B.a, B.b, B.c, and B.g), as well as the main species' groups addressed in international bird conservation plans (B.d, B.e, and B.f). Subgoals under Goal C identify the priority public uses for which opportunities would be provided under Alternative C.

of particular species, including species highlighted in regional conservation plans, may be used to adjust management practices where this is deemed necessary and within the general framework established by this alternative. Parallel with the natural swell in springtime wetland-habitat, providing breeding habitat for wetland birds and other wetland wildlife would be emphasized under this alternative. This would complement the management of other wetland areas in the Lahontan Valley (e.g., Carson Lake), which emphasizes fall and winter habitat for these birds. Another principle inherent to this alternative is that natural vegetative structure is an important component of the natural biodiversity in meadow, marsh, riparian, and upland habitats, and it is in short supply in many of these habitats in the Lahontan Valley. In contrast, the availability of temporarily shallowly-flooded pasture and other areas of short vegetation is abundant in the Lahontan Valley during the spring.

General Approach to Producing these Habitat Conditions. An underlying principle of refuge management under this alternative is that mimicking natural processes is a fundamental and necessary part of restoring the biological integrity and health of the ecosystem, and its natural biodiversity (USFWS 1999). However, it would be recognized under this alternative that mimicking natural hydrologic patterns with a limited water supply (among other factors, such as occurrence of nonnative plants and contaminants) would not result in the exact habitat conditions that would occur under natural conditions. Although peak wetland-habitat acreage would occur during early spring, the natural hydrologic patterns would be adjusted to minimize nest-flooding, enhance winter waterfowl habitat, and to provide additional acres for waterfowl hunting (as compared to mimicking the natural seasonal flow pattern; i.e., Alternative D). The adjustments take into account the significant reduction in wetland-habitat acreage in the Interior Basins Ecoregion and its effects on wetland-dependent migratory birds. Figure 3.1 illustrates one of the ways in which the objectives of this alternative differ from the objectives developed for other alternatives.

Under this alternative, it is assumed that natural ecological conditions and processes, including the hydrologic regime, produced a particular range of conditions in the Carson Desert, and that these are the conditions under which particular communities of plants, animals, and microorganisms were formed and sustained. This alternative recognizes that the assemblages under natural conditions were in a dynamic flux over time in response to ever-changing ecological conditions. Therefore, fluctuations in plant and animal populations would be expected and allowed. This alternative places habitat management in the context of process management and it recognizes our limited understanding of the diversity of plants, animals, and microorganisms, and the diversity of biotic processes that would occur under natural conditions. By focusing efforts exclusively on providing habitat for taxa for which we have adequate information (e.g., waterfowl, certain shorebirds and other waterbirds), we may be managing against species for which information is limited or nonexistent, or simply against species that were not selected as key species. Thus, by targeting a natural functioning of ecological processes (of which our understanding is relatively high) and natural composition of habitats, the needs of these species could be accommodated without the Service actually knowing this is occurring (Wallin et al. 1996).

To the extent practical and feasible, construction, maintenance activities, and habitat management practices would be designed and undertaken so that the appearance of naturalness is restored and maintained. This includes mitigating past actions, such as eliminating or substantially lowering the piles of soil dredged from canals.

Special Area Designation: If the Alternative C boundary is formally adopted and approved, the area within this boundary would be further evaluated for its value as a Research Natural Area and its wilderness potential, with an emphasis on Research Natural Area. Given this alternative's management direction in the contiguous sand dunes and adjoining salt desert shrub communities, either of these designations would contribute to the goal of restoring and maintaining natural biological diversity.

Compatibility. Under this alternative, compatibility determinations would evaluate the potential effects of public uses on the full range of biodiversity components, elements of wildlife conservation and international treaties, each of the priority public uses, as well as regional and flyway-level parameters. This alternative recognizes a distinction between a public use program and human disturbance management (Morton 1995). The former focuses on positive aspects of refuge visitation (promotion of public use to satisfy public needs and to achieve public use goals), whereas the latter focuses on ensuring that human disturbance resulting from refuge visitation does not impair the achievement of wildlife goals, by its very nature a "negative" subject. Human disturbance management, the primary subject of compatibility determinations, would be addressed within the biological program. This approach would allow the public use program to continue to promote Stillwater NWR as a destination for birdwatching, hunting, and environmental education, yet allow the biological program to maintain an effective check on how this use is managed to ensure that the refuge continues to provide high-quality habitat for wildlife. Under this alternative, attempts would be made to proactively manage human disturbance in a way that avoids future compatibility problems, minimizing the extent to which changes have to be made to public use in response to problems.

Monitoring. Recognizing the importance of a sound monitoring program in a successful management program, increased emphasis would be placed on monitoring the status and trends of fish, wildlife, and plant populations and their habitat on each refuge (Refuge System Admin. Act, Sec. 5(3)(N)). Priority in the monitoring program would be given to tracking long-term wetland-habitat acreage, long-term waterfowl and shorebird data sets, and habitat, while ensuring that representatives of each guild and habitat type occurring on the refuge complex are monitored, at least at some level.

Objectives and Strategies

Goal A: Conserve and manage fish, wildlife, and their habitat to restore and maintain natural biological diversity.

Subgoal A.a: Approximate natural diversity within and among animal communities on Stillwater NWR.

This subgoal and the accompanying objectives below would be achieved primarily through strategies outlined under Subgoals A.b and A.c. In other words, wildlife would be managed in large part through managing their habitat. The boundary-revision proposed under this alternative would also contribute to the accomplishment of this subgoal and objectives. Migratory waterbirds and neotropical migratory birds are important components of the area's natural biological diversity. Several population and use-level objectives have been identified for some birds and groups of birds at the flyway, regional, state, and local levels in international bird conservation plans, including the Intermountain West Joint Venture Implementation Plan (Intermountain West Joint Venture 1995) and Nevada Partners in Flight Bird Conservation Plan (Partners in Flight 1999). Although population or use-level objectives would not be established for Stillwater NWR under Alternative C, objectives and strategies under Goal A would generally support the population targets identified in the bird conservation plans. Objectives and strategies of these plans are further addressed in Goal B.

Objective A.a.1: Restore and perpetuate the presence of all native species and native guilds of birds, mammals, reptiles, amphibians, fish, and invertebrates, according to season (Appendix B).

Objective A.a.2: Approximate the relative (e.g., rare, uncommon, common, abundant) population levels (or, use level of the refuge) of native wildlife species that would exist under natural conditions, according to season and recognizing natural fluctuations in populations, through the use of representative species (for monitoring purposes).

Basis of Objectives: Richness and relative abundance of native species is a major component of natural biological diversity.

Strategies to Achieve Objectives: These objectives would be accomplished primarily by continuing to protect habitat on refuge lands within the approved refuge boundary and by sustaining refuge habitats in conditions outlined in forthcoming habitat objectives. Under this alternative, the Service would allow for fluctuating wildlife populations, which is a characteristic of Great Basin marsh ecosystems.

Because some species of native wildlife, when their populations become unnaturally high, can have unusually high impacts on other native wildlife species, measures may be taken to alleviate these problems by directly controlling populations of target species. As a general rule, however, management would allow populations of native wildlife species to fluctuate unabated. Exceptions to this are presented in more specific objectives that follow.

The wildlife population management strategies described under forthcoming objectives would be undertaken in a way that recognizes the role of all native species in the refuge's ecosystem and the relative composition of these species in native wildlife communities. Any control programs would make use of the most humane method possible.

One group of wildlife that is not addressed later is mosquitos. Recognizing that mosquitos are native wildlife and are natural and important components of the wetland ecosystem, no active control of mosquitos would be undertaken on Stillwater NWR. However, their populations would continue to be controlled by native and nonnative insectivores, including mosquito fish (a nonnative species) which could become abundant on Stillwater NWR. A contingency plan would be developed in conjunction with the Churchill County

Mosquito Abatement District to identify actions to take in the event of an encephalitis outbreak (There are no recorded problems of this in Churchill County).

Monitoring Elements: All major taxonomic groups would be addressed in monitoring program which would allow trends in abundance or use levels of species within these groups to be tracked over time. Emphasis would continue to be placed on marsh wildlife, but increased emphasis would be placed on riparian and upland species.

Objective A.a.3: Minimize distribution and abundance of nonnative animal species and their prominence in fish and wildlife communities, in the near term focusing on:

(a) Reducing, to the greatest extent possible, populations of European carp and other nonnative fish populations in Stillwater Marsh wetland units, while maintaining high populations of tui chub,

(b) Exploring and identifying practical and cost-effective ways to significantly reduce bullfrog numbers in designated areas.

(c) Determine whether other nonnative species should be controlled, and implement needed control measures.

Basis of Objectives: In general, the extent to which nonnative fish and wildlife species are eliminated or reduced in number, the diversity of native species will increase. This is because presence of nonnative species proportionally reduces the composition of native species, and because nonnative species compete with, prey on, and impair habitat of native species, further reducing natural biodiversity. This objective addresses one of the core problems of Stillwater NWR and is of high priority.

Strategies to Achieve Objectives: Carp and other nonnative fish species would be controlled through water management (e.g., drying of wetland units) and possibly through the limited use of pesticides. No species of nonnative fish would be stocked or otherwise intentionally introduced into Stillwater NWR. Precautions would be undertaken to avoid fish kills that could result in a botulism outbreak.

A step-down plan would be prepared within 2 years that further analyzes the problems associated with particular nonnative wildlife species, provides an assessment of whether control measures should be implemented for each species and an assessment of the cost-effectiveness of control, and identifies the control measures to be implemented. Strategies evaluated would focus on specific units where nonnative plant species have become a hindrance to meeting habitat management objectives.

In carrying out nonnative fish control measures, it would be recognized that white pelicans and other species make heavy use of carp and other nonnative fish as a food source. Therefore, control efforts would not be initiated marsh-wide in any given year.

Monitoring Elements: Distribution and relative indication of density or abundance of carp, other nonnative fish, and bullfrogs.

Subgoal A.b: Approximate, within a natural range of variability, a natural diversity within and between plant communities and habitat types (the latter including nonvegetated habitat types and physical attributes of habitat such as water depth and water chemistry).

Objective A.b.1: Restore and perpetuate the presence of all native plant species (Appendix B) and native plant communities in Stillwater Marsh, Carson River corridor and its delta, Stillwater Slough corridor, dune complex, and salt-desert shrub uplands.

Basis of Objectives: Richness of native plant species and communities is a major component of natural biological diversity.

Strategies to Achieve Objectives: The presence of all native plant species and communities will be maintained to the extent that strategies under Objectives A.b.2(a-e), A.b.3(a-c), A.b.5, A.c.1, and A.c.2 are carried out. However, in some cases reintroduction may be necessary. The reintroduction of extirpated plant species would be evaluated.

A more thorough assessment would be made of the native plant species of the Stillwater area, including a review of existing archaeological reports, field notes, museum collections, and possibly through additional examination of archaeological deposits.

Monitoring Elements: Number and type of plant communities and habitat types occurring on Stillwater NWR.

Objective A.b.2: Approximate and perpetuate the mix of plant communities and habitat types that would occur on Stillwater NWR under natural conditions — within a natural range of variability — including representation by all native plant communities and habitat types, amount of area occupied by each plant community and habitat type, and the distribution and pattern (shape) of each.

Basis of Objective: The pattern, distribution, and amount of area occupied by each native plant community type are major components of natural biological diversity and have major and direct effects on the diversity of wildlife that can be supported.

Strategies to Achieve Objectives: The strategies to achieve this objective would vary depending on the ecological setting (Stillwater Marsh, Carson River and Stillwater Slough, the Carson River delta, and uplands), and these are presented below.

Monitoring Elements: These are presented below for each ecological zone.

Objective A.b.2(a): Attain and sustain a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR, including marsh (palustrine), shallow lake (lacustrine), and riverine wetland-habitat as described in more detail below.

Basis of Objectives: Public Law 101-618 (Subsection 206(a)) requires that 25,000 acres of primary wetland-habitat be maintained in the Lahontan Valley. Of this target, 14,000 acres will be maintained on Stillwater NWR(USFWS 1996a, b). Furthermore, this objective addresses one of the core problems of Stillwater NWR.

Strategies to Achieve Objectives: Water rights and water would continue to be secured as outlined in the 1996 WRAP EIS/ROD until it is determined that a long-term average of 14,000 acres of wetland-habitat is being maintained on Stillwater NWR(USFWS 1996a,b). Acquiring water rights for Stillwater NWR wetlands also supports directives in the Refuge System Administration Act, as amended, to acquire water rights needed for refuge purposes, and strategies identified in the Nevada Partners in Flight Plan and the U.S. Shorebird Conservation Plan, Intermountain West Region.

Monitoring Elements: At present, the record of decision for the WRAP EIS specifies that wetland-habitat acreage will be monitored annually in August. Alternatives to this are being evaluated in this Draft EIS (Section 4.3.3.1). During the surveys, wetland-habitat acreage will be determined by the total acreage of the wetted area within wetlands.

Stillwater Marsh (A.b.2(b)):

Objective A.b.2(b)(i): Attain and sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh in a way that attains the following seasonal targets (see table below for actual acreages for representative inflow volumes):

- 75-100 percent of annual-peak acreage during April-June, with the peak occurring in late March or early April prior to major nest initiation;
- 40- 70 percent of annual-peak acreage during July-September (>50 percent in July);
- 55-70 percent of annual-peak acreage during October-February.

For several representative water-inflow levels, this translates to:

Annual Wetland Inflow (acre-feet)	Objective Wetland-Habitat Acres for Stillwater Marsh[A]			Objective Long-term Average
	Apr-Jun	Jul-Sep	Oct-Feb	
20,000	5,000-7,000 ≥6,000 April peak	2,500-5,000 (July > 4,000)	4,000-5,000	—
35,000	7,500-11,000 ≥9,000 April peak	4,000-8,000 (July >6,000)	6,000-7,500	—
50,000	11,000-15,000 ≥12,000 April peak	6,000-10,000 (July > 8,000)	8,000-10,000	—
65,000	15,000-18,000 ≥16,000 April peak	7,000-14,000 (July >11,000)	10,000-13,000	12,500[B]
spill-year	same as appropriate representative year above (according to average inflow during nonspill years), or more per season			—[B]

[A] Objectives assume that the previous year had the same or lower inflow volume. If it was higher, the stated objectives would be minimum acreages.

[B] The long-term objective for nonspill years (an average of 12,500 acres of wetland-habitat) years) assumes a long-term average of 16,500 acres during spill years (1 of 4 years), which would be needed to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. The 16,500-acre estimate for spill years is not an objective.

Basis of Objective: This objective and the following strategies support Objectives A.b.1-A.b.2(a). It addresses one of the core problems facing the refuge and would be

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emphasized. Maintaining a long-term average of 13,500 acres of wetland-habitat would contribute toward the target of 14,000 acres for the refuge.

Mimicking the seasonal pattern of wetland-acreage is key to approximating the natural diversity of plants and animals occupying the marsh. Peak acreage under natural conditions typically occurred between April and June, and the low point was generally in August/September. The natural seasonal pattern was adjusted somewhat to minimize nest flooding during April-June, and to ensure that an acceptable amount of wetland-habitat is provided in the fall and winter. Fall and winter wetland-habitat was extensive in the Lahontan Valley under natural conditions, and Stillwater Marsh is important to migrating and wintering waterbirds in the Great Basin.

By tailoring management to achieve the above stated objective, important hydrologic functions would be simulated, such as declining water levels during July-October, rising water levels during the early spring, and to some extent higher springtime flow rates into and through wetland units.

At a regional and flyway level of restoring natural biological diversity, the objective also contributes toward wetland-habitat goals and objectives of the Intermountain West Joint Venture, Nevada Partners in Flight, and U.S. Shorebird Conservation Plan Intermountain West Region.

Strategies to Achieve Objectives: A natural seasonal flow-volume pattern and natural seasonal fluctuations in water levels would be approximated, modified slightly to minimize impacts to nesting waterbirds and accommodate fall migration and wintering habitat for waterfowl and for waterfowl hunting, through the following strategies. Deliverable water, including acquired and leased water rights, would be delivered to Stillwater NWR in the following proportions of the annual volume (this does not include spill-water, drainwater, or groundwater pumping):

	Dec-Feb	Mar-Jun	Jul-Sep	Oct-Nov
Low water-year	0-10%	50-80%	0-30%	0-15%
Full water-year	5-10%	50-70%	20-30%	10-15%
Spill year	0-10%	30-60%	20-40%	10-30%

Water levels would be raised above operational levels temporarily in March, prior to the onset of nesting, to recharge wet meadow shoreline habitat, thus simulating a naturally-occurring pulse. This would require up to about 30 percent of the annual allocation to be delivered in March. (In spill years, this pulse could occur anytime between November and June.) Starting in April, attempts would be made to maintain a constant level through May or June. To achieve habitat objectives, about one-third of the annual supply of deliverable water would have to be delivered to Stillwater NWR before April 1. If water delivery cannot start before March 15, this volume of water would have to be delivered in a two week period.

Water levels throughout most of the marsh would be allowed to decline starting in late June or July, but care would be taken to ensure that sufficient water levels would be maintained for brooding habitat at least through mid-July. Declining water levels would be permitted to proceed through December, January, or February in some of these wetland units (roughly 1/3 of the units or acreage). The strategy of allowing water levels to decline during the late summer and fall would benefit fall-migrating shorebirds by concentrating and exposing invertebrates as water levels decline.

In the other wetland units, declining water levels would be curtailed in September or October. Water levels in roughly half of these units (about 1/3 of the refuge units) would remain stable from September through December. In the remaining units (roughly 1/3 of refuge units), approximation of natural hydrologic functioning would cease until about January, and management for specific needs of waterfowl would be undertaken (see strategies for Objective B.e.2).

The preceeding discussion addressed the delivery and management of water during nonspill years. In spill years when sufficient water is available, deliveries could be delayed until after conveyance of spill-water onto the refuge ceases to provide additional wetland habitat during the late summer, fall, and winter, which would also result in carryover water to the next year.

Monitoring Elements: Water receipts, wetland-habitat acreage by season.

Objective A.b.2(b)(ii): Approximate a natural diversity of Stillwater Marsh habitats by targeting the following mix of habitats, with intervening months being managed as transition periods.

Low-water Conditions (seasonal range = 2,500 - 7,000 acres of wetland habitat[A])

Habitat Type (and annual-peak depth)	Annual	Apr-Jun	Aug-Sep	Oct-Dec
Deep, unvegetated zone (3-6 ft)	1-2%	1-2%	1-2%	1-2%
Submergent marsh (1-3 ft)	20-45%	20-35%	30-45%	25-40%
Deep emergent marsh (1-3 ft)	20-45%	20-35%	30-45%	20-35%
Shallow emergent marsh (0.1-2 ft)	0-35%	10-30%	0-30%	10-35%
Wet Meadow (0.1-1 ft)	0-15%	5-15%	0%	0%
Moist-soil[D] (0.1-1 ft)	0-15%	5-15%	0-5%	5-15%
Unvegetated Mudflat (0.1-0.5 ft)	5-10%	5-10%	5-10%	5-10%

[A] Assumes a full-water year with about 17,,000 acre-feet of water available for wetland delivery (20,000 acre-feet of water rights acquired), or a shortage year at a later stage of the acquisition program, equivalent of this annual volume of water.

Moderate Water Conditions (seasonal range = 6,000 - 15,000 acres of wetland habitat)

Habitat Type (and annual-peak depth)	Annual	Apr-Jun	Aug-Sep	Oct-Dec
Deep, unvegetated zone (3-6 ft)	2-4%	1-3%	2-4%	2-4%
Submergent marsh (1-3 ft)	20-40%	20-30%	30-40%	25-40%
Deep emergent marsh (1-3 ft)	20-40%	20-30%	30-40%	20-40%
Shallow emergent marsh (0.1-2 ft)	5-30%	15-30%	5-25%	10-25%
Wet Meadow (0.1-1 ft)	0-20%	10-20%	0%	0%
Moist-soil[D] (0.1-1 ft)	0-15%	10-15%	0-5%	10-15%
Unvegetated Mudflat (0.1-0.5 ft)	5-15%	5-10%	5-15%	5-10%

[B] Assumes a full-water year with about 30,000 acre-feet of water available for wetland delivery (35,000 acre-feet of water rights acquired), or a shortage year at a later stage of the acquisition program, equivalent of this annual volume of water.

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High-Water Conditions (seasonal range = 7,000 - 18,000 acres of wetland habitat)

Habitat Type (and annual-peak depth)	Annual	Apr-Jun	Aug-Sep	Oct-Dec
Deep, unvegetated zone (3-6 ft)	1-4%	2-4%	1-2%	1-3%
Submergent marsh (1-3 ft)	20-35%	20-30%	25-35%	20-35%
Deep emergent marsh (1-3 ft)	15-40%	15-35%	25-40%	20-35%
Shallow emergent marsh (0.1-2 ft)	10-30%	10-25%	10-20%	10-25%
Wet Meadow (0.1-1 ft)	0-25%	10-25%	0%	0%
Moist-soil[D] (0.1-1 ft)	0-15%	10-15%	5-10%	10-15%
Unvegetated Mudflat (0.1-0.5 ft)	5-15%	0-10%	5-15%	5-10%

[C] Assumes a full-water year with about 47,000 of water available for wetland delivery (completion of acquisition program).

[D] Moist-soil habitat, for the purposes of this objective, includes saltgrass and other shoreline or meadow vegetation that is flooded during the fall to provided food for dabbling ducks.

Basis of Objectives: Second to increasing the acreage of wetland-habitat, restoring a natural mix and within-community composition of wetland-habitat types may have the greatest, positive effect on the Service's ability to approximate a natural diversity of wildlife in Stillwater Marsh.

The percentages shown above were based on estimates of the natural composition of the marsh, adjusted in places to account for things such as (1) the fact that it would not be possible to restore the deep-water channels to cover the extensive area they historically covered without significant changes to infrastructure, and (2) emergent vegetation was at times higher than shown, but this would adversely affect some species of interest and thus approximation of the high end would not be sought. Within-community composition is addressed under Objective A.b.3.

Strategies to Achieve Objective: The water management strategies described under Objective A.b.2(b)(i), including seasonal pattern of inflow and rate of flow, would be the primary means to achieve this objective, but the following strategies would also be undertaken.

In establishing annual water management plans, the wetland manager would recognize the influence that topography, geomorphology, and soils have on wetland plant communities and habitats, especially as this pertains to mimicking natural habitat conditions. Although these physical elements cannot be managed to any large degree, wetland managers would take these factors into consideration when deciding which wetland units would receive water.

The natural geomorphology and topography of the historic marsh and surrounding area would be emphasized, which may require action such as: (1) recontouring certain wetland units to create deeper channels; (2) removing spoil-banks along canals; and (3) removing certain dikes, after a detailed analysis of whether they are needed and whether their adverse impacts outweigh the benefits of maintaining them. The criteria would include water management efficiency and other issues (efficient use of limited water, impediments to water movement, necessity to achieve habitat objectives and to carry out other strategies) and biological issues (habitat quality and diversity, predation and nest

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depredation rates, human disturbance). Creating deeper channels may be needed to produce deep-water habitats that were once prevalent in the marsh, especially along the main flow routes in the center of the marsh.

Other tools for mimicking a natural mix of plant communities and habitat types may include prescribed burning, disking, cattle grazing and trampling, as well as allowing muskrats to graze unabated.

Monitoring Elements: Seasonal acreage of each wetland-habitat type.

Objective A.b.2(b)(iii): Within five years, examine the feasibility and, if appropriate, develop a plan to restore native wet-meadow habitat on the properties formerly owned by the Kents and Weishaupts.

Basis of Objective: Wet-meadow habitat in its natural condition, once covering thousands of acres, is nearly nonexistent in the Lahontan Valley. This area is within the historic flood-plain of the Stillwater Slough.

Strategies to Achieve Objective: Objectives and strategies for restoring wet meadow communities and other wetlands on previously farmed areas of the properties formerly owned by the Kents and Weishaupts would be detailed in an operational plan. The plan would include appropriate contouring to simulate the natural topography and to facilitate mimicking the natural hydrology. The plan would contain the provision that local sources of native species (e.g., seeds and cuttings collected locally) would be emphasized and species not native to the Lahontan Valley would be avoided in all revegetation efforts and other plantings. Native vegetation would be reestablished through practices such as seeding, planting seedlings and cuttings, in addition to fostering and allowing natural colonization and recruitment.

Monitoring Elements: Acres of wet meadow habitat restored in the specified area.

Carson River and Stillwater Slough (A.b.2(c)):

Objective A.b.2(c)(i): Attain and sustain a long-term average of at least 100 acres of riverine-wetland-habitat on Stillwater NWR.

Objective A.b.2(c)(ii): Restore cottonwood, mesic shrub (e.g., willow, rose, buffalo-berry), wet meadow, riverine-aquatic communities to their natural distribution and extent along the lower Carson River and Stillwater Slough *(see objectives under Subgoal A.d., Monitoring and Management Studies).*

Basis of Objectives: The low-elevation, riparian cottonwood community is one of Nevada's most threatened biological communities. This is also one of the three major components of the Lahontan Valley wetland system. Given sufficient water and protection, the lower Carson River holds great restoration potential.

Strategies to Achieve Objectives: A major strategy would be to restore or approximate the natural geomorphology and hydrologic functioning of the Carson River and side

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channels, and of the Stillwater Slough, recognizing that water flows and channel dimensions would be scaled to the peak water volumes available under anticipated future conditions. To this end, a baseline survey of the river and slough would be conducted to determine the existing width/depth ratios, sinuosity, depth of incising, and other geomorphologic characteristics. A more detailed assessment would be made of the natural conditions of these features, including further examination of archaeological field notes and ethnographies. A more thorough assessment would be made of the native plant species occurring in the Stillwater area, including a review of existing archaeological reports, field notes, and museum collections, and possibly through additional examination of archaeological deposits. Objective levels of each attribute would be based on estimated natural conditions and the anticipated maximum, minimum, and frequency of surface water flows.

Based on the outcome of the baseline survey and objective-setting, an operational plan would be prepared that identifies management actions needed to achieve objectives; with an emphasis on nonengineering solutions. As part of the strategy, the Service would acquire, on a willing seller basis as part of the water-rights acquisition program, land and associated water rights along the lower Carson River corridor for use in restoring this riparian area. The Service would also continue to work with the Bureau of Reclamation and its contractor, TCID, to ensure that Carson River water released or spilled from Lahontan Reservoir during precautionary releases is conveyed to the lower Carson River as provided for under the Emergency Release Criteria for Lahontan Reservoir (USBOR 1997b).

Native vegetation would be reestablished through practices such as seeding, planting seedlings and cuttings, in addition to fostering and allowing natural colonization and recruitment. Revegetation objectives and strategies for riparian would be detailed in an operational plan. The plan would include the provision that local sources of native species (e.g., seeds and cuttings collected locally) would be emphasized and species not native to the Lahontan Valley would be avoided in all revegetation efforts and other plantings. During the interim, while the operational plan is being developed, the following actions would be continued or initiated: (1) cuttings and/or seedlings of cottonwoods, willows, wild rose, and buffaloberry would be planted along the Carson River and Stillwater Slough in coordination with efforts to restore the geomorphology of the water channels (e.g., banks would not be re-vegetated if there is a possibility they would be recontoured); and (2) seedlings and cuttings would be protected from mule deer, beaver, and other herbivores.

Monitoring Elements: Seasonal acreage of wetland-habitat, distribution and acreage of each riparian vegetation type, and riverine geomorphological features.

Carson River delta (A.b.2(d)):

Objective A.b.2(d)(i): Attain and sustain a long-term minimum average of 400 acres of wetland-habitat in the Carson River delta.

Objective A.b.2(d)(ii): During years when water reaches the Carson River delta via the Carson River (spill-years), approximate natural habitat conditions *(see objectives under Subgoal A.d., Monitoring and Management Studies).*

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Basis of Objectives: By maintaining the Carson River delta within a primary wetland area, it would contribute to attaining the valley-wide target of 25,000 acres of primary wetland-habitat. Approximating natural habitat conditions would contribute significantly to the approximation of natural wildlife diversity.

Strategies to Achieve Objectives: The Service would continue to work with the Bureau of Reclamation and its contractor, TCID, to provide the highest possible flow volumes down the Carson River to its delta during precautionary releases and spills from Lahontan Reservoir, as outlined in the Emergency Release Criteria for Lahontan Reservoir (USBOR 1997b). In the near term, this would be the only water reaching the marsh.

Through examination of historical and archaeological information, estimates of Carson River and Humboldt River hydrologic regimes, topography of the Battleground area, known relationships between hydrologic conditions and vegetation response, and other information, a better estimate of natural habitat conditions in the Carson River delta would be obtained (see Subgoal A.d). Long-range objectives would be developed based on this information.

During the interim, prior to development of specific long-range objectives for the Carson River delta area, the following strategies would be carried out. The natural timing and flow-rate through the delta wetlands would be approximated by: (1) maximizing the amount of water flowing through the wetlands during Lahontan Reservoir precautionary releases and spills; (2) providing input into the U.S Army Corps of Engineer's study of the Fallon flood-abatement study and participating in the development of any subsequent plans based on the study; (3) allowing the Carson River to flow into the Carson River delta unabated during years of Lahontan Reservoir precautionary releases and spills; and (4) allowing water levels to decline through evapotranspiration following cessation of water inflow.

Monitoring Elements: Seasonal wetland-habitat acreage, acres of habitat types.

Upland Areas (A.b.2(e)):

Objective A.b.2(e)(i): Restore, approximate, and maintain the natural distribution and abundance of upland plant communities and habitat types that would exist naturally, according to location, throughout upland portions of the refuge.

Basis of Objectives: Although not as diverse as marsh and riparian biotic communities, upland communities are a major component of the Lahontan Valley's biological diversity. Approximating natural vegetation characteristics is key in restoring these communities. The plant communities have been impacted by the introduction of nonnative plant species and livestock grazing, which in turn has impacted native fauna associated with these habitats.

Strategies to Achieve Objectives: Removing livestock grazing from upland areas on the refuge would be the main strategy for restoring these habitats. In general, upland areas would be permitted to recover on their own, but options would be explored to facilitate recovery..

While wide-scale efforts to eliminate nonnative invasive species in upland habitats is not practical, reduction in targeted areas or elimination of unnatural processes leading to these

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suspected changes can be accomplished. Tracking invasive species' distributions, expansions, and reductions is paramount to restoring upland plant community integrity, by identifying areas where nonnative species (including Russian thistle, saltcedar, and cheat grass) have become well established and provide a source of seeds to spread into new areas. Once identified, control efforts including herbicide application, prescribed burning, and limited mechanical treatments can be applied to eliminate high density seed sources.

Monitoring Elements: Distribution and acreage of upland habitat types and plant communities.

Objective A.b.3: Approximate, within each habitat type and plant community, a natural species composition; emphasizing the domination of these communities by one or more native species representative of the community (Table 2.2) and reduce, or eliminate, if possible, the number of nonnative species.

Objective A.b.3(a): For each habitat type and plant community, determine the approximate proportion that each of the major plant species should comprise within the community, and develop targets based on this assessment.

Basis of Objectives: Within-community plant species composition is a major component of the area's biological diversity, and it can have a marked effect on wildlife diversity and use by particular wildlife species.

Strategies to Achieve Objectives: Strategies and management actions to achieve targeted compositions would be developed upon further examination. Historic accounts, ethnographies, and plant-environment relationships information could be used to determine the relative composition of dominant plant species for selected major plant communities being restored on Stillwater NWR. Objectives and strategies would be developed based on this information where appropriate. Strategies for achieving these objectives would be similar to those under other objectives (Objectives A.b.2(b)(iii), A.b.2(c)(ii)), A.b.3(b-c)).

Monitoring Elements: Set of objectives addressing the relative canopy cover or density of major plant species in plant communities.

Objective A.b.3(b): Prevent the establishment of any nonnative species not already present within the boundaries of Stillwater NWR, especially species listed as a noxious weed (e.g., purple loosestrife, Eurasian water milfoil).

Basis of Objectives: Nonnative species detract from natural plant diversity and, once established, some nonnative species can dominate whole communities to the exclusion or near exclusion of native species. Preventing additional nonnative species from becoming established would reduce significant resources being expended later to control them.

Strategies to Achieve Objectives: Place restrictions as appropriate on public uses to minimize the chance of new species being introduced to the refuge. Continue to coordinate with local agencies, private groups, and individuals to prevent upriver populations spreading to the refuge and to prevent new species from being established in the river basins.

Monitoring Elements: Up-to-date list of nonnative species occurring on Stillwater NWR, list of potential nonnative species occurring outside the refuge.

Objective A.b.3(c): Curtail the spread of noxious weeds and other nonnative invasive vegetation within Stillwater NWR, and reduce the amount of area dominated by saltcedar and perennial pepperweed, including reducing the composition in plant communities.

Basis of Objectives: Nonnative plant species detract from a natural diversity of plants and animals in several ways, and for several nonnative species, their active control outweighs the benefits of taking a hands-off approach to conserving natural parts of the ecosystem. Higher composition (e.g., density, canopy cover) of nonnative species reduces the composition of native species in plant communities and, once established, some nonnative species can dominate whole communities to the exclusion or near exclusion of native species. This is a critical issue at Stillwater NWR, second only to water issues.

Strategies to Achieve Objectives: The occurrence of nonnative plant species in plant communities would be minimized, with an emphasis on controlling those species having the most detrimental impacts to plant community composition and structure. Active control would be undertaken where necessary. An operational plan would be developed that would include:

1. Continued control of saltcedar and perennial pepperweed (tall white-top), prioritized according to the map of noxious-weed control zones, using mechanical and herbicide treatments;

2. Continued promotion of Stillwater NWR as a possible test site of the Chinese leaf beetle for controlling saltcedar;

3. Development of an integrated pest management (IPM) plan, in which the reliance on herbicides for controlling nonnative vegetation would be reduced. Under Service policy, the ultimate goal of IPM is to reduce pesticide use on Service lands and facilities to the minimum practical extent, and to encourage pest management programs that benefit trust resources and provide long-term, environmentally sound solutions to pest management problems on sites off of Service lands (30 AM 12.3). Integrated pest management is a method for pest management decision-making.

   Integrated pest management is defined as "the control of pests utilizing a practical, economical, and scientifically-based combination of biological, physical, cultural, and chemical control methods" (30 AM 12.5). It is a balance approach which considers hazard to the environment, efficacy, costs, and vulnerability of the pest. "The ultimate goal is to eliminate pesticide use on Service lands and facilitate, where possible, and to encourage pest management programs that benefit trust resources and provide long-term, environmentally sound solutions to pest management problems on sites off of Service lands."

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Control tactics in the plan may include: flooding or dessication; mechanical treatments (e.g., chainsawing, rooting, disking); prescribed burning (to be addressed in a Fire Management Plan); introduction of host-specific insects (e.g., Chinese leaf beetle); grazing or browsing by goats or sheep for noxious weeds; grazing by cattle agricultural fields and ditches in the farmland area to reduce weeds; and herbicides (minimized to the extent possible). For the foreseeable future, herbicides (e.g., Rodeo) would be needed as part of an IPM plan to control saltcedar. Efforts would be made to form partnerships with adjacent landowners, other Federal and non-Federal agencies, and organizations to control undesirable vegetation at a landscape level. Noxious weed control priorities would be according to zones.

Chemical control methods would be necessary during initial phases of control efforts and with broadly-distributed species, but chemicals would be used only when it is determined that they are the most appropriate management tool available. For example, tall whitetop is sporadically distributed at low densities. The control technique currently used is hand pulling individual plants as they are located. However, chemical control has been more effective as wider distribution of tall whitetop has occurred. No control methods are currently practiced for Russian olive or purple loosestrife. All of these species and other potential invasive species will be covered in the stations integrated pest management plan which will be completed concurrent with the comprehensive conservation plan.

As a measure to prevent the spread of undesirable invasive species in upland areas, livestock grazing would not be permitted in native upland habitats and horseback riding would be restricted to open roads.

Monitoring Elements: Distribution, within-community species composition, and rate of spread.

Objective A.b.4: Approximate, within each habitat type and plant community, the vegetative structure of plant communities that would occur under natural operation of ecological processes, such as spring flooding, drought, succession and competition, accumulation of residual plant material, herbivory, seed caching, long intervals between fires, including:

Stillwater Marsh and Carson River delta (A.b.4(a)):

(i) A natural pattern of emergent vegetation and open-water areas in the marsh that is maintained by deeper channels and by disturbances such as spring flooding and muskrat grazing, or secondarily, a mosaic that simulates natural disturbances; and
(ii) Portions of the marsh having residual vegetation that has accumulated for many years (e.g., five years or more).

Basis of Objectives: Horizontal structure (e.g., pattern, shape of plant communities and habitat types) and vertical structure are major components of an area's biological diversity and they have a considerable influence on wildlife diversity, further affecting biodiversity.

Strategies to Achieve Objectives: Beyond the strategies for achieving Objective A.b.2(b)(ii), which focused on approximating geomorphology of the marsh and other physical attributes, the following actions would be undertaken to achieve this objective.

Muskrats would be allowed to graze on emergent vegetation, unabated. However, the following factors would be considered: (1) muskrat control measures may be necessary while emergent vegetation is recovering in some units, or possibly to avoid over grazing by the muskrats if this is deemed undesirable; (2) muskrat control may be needed along dikes — in these cases, muskrats would not be trapped further than about 100 feet from dikes; and (3) a study would be initiated to examine the relationships between muskrats and marsh ecology, to ascertain whether environmental conditions would allow muskrat populations to reach deleterious levels (part of the study may involve allowing the population to climb without any control to see what happens to the habitat and population). The study would include a review of existing literature on muskrat management. Any muskrat control program would recognize their natural role in the wetland ecosystem.

Grazing and browsing would be managed to simulate natural rates of herbivory by carrying out the following strategies. Livestock grazing would be excluded from Stillwater Marsh and the Carson River delta, except as prescribed under the strategies described under Objectives A.b.3(c) and B.e.1, which would require boundary fencing along the external boundary and certain inholdings. Livestock grazing on the entirety of Stillwater NWR in any given year would not exceed 500 AUMs under this alternative.

The frequency and extent of fires on the refuge would be minimized, except as needed to achieve other wildlife habitat objectives, and a fire suppression program (especially for upland areas invaded by cheatgrass) would be developed and implemented as part of a Fire Management Plan being developed (Appendix K). However, fire could be used to manage farmland vegetation and to manage emergent vegetation when it has become dense and decadent in significant parts of the shallow emergent, deep-emergent, and submergent aquatic zones. Prescribed burning efforts would recognize that dense stands of marsh vegetation, lasting season after season is a significant component of the natural marsh environment. Habitat management zones would be established for prescribed burning and other practices. As noted above, prescribed fire would be an important component of the integrated pest management plan.

Monitoring Elements: Acreage and distribution of marsh plant communities and habitat types, acreage and distribution of areas having residual vegetation, vegetation height, density, and age of decadent plant material.

Lower Carson River and Stillwater Slough (A.b.4(b)):

(i) An overstory of cottonwoods and/or willows along most stretches;
(ii) An understory of native grasses and grass-like plants, forbs, and young cottonwoods and mesic shrubs (e.g., willows, rose, buffaloberry); and
(iii) Some areas dominated by grasses and grass-like plants (i.e., no woody overstory);
(iv) Carry-over of native herbaceous plant material (residual vegetation) from season-to-season and year-to-year during most periods, recognizing that spring flooding would naturally have matted some vegetation and induced decomposition, and that fires (late summer or fall) would have been infrequent.

Basis of Objectives: A natural vegetative structure in riparian areas is critical to approximating a natural diversity of wildlife in these areas.

Strategies to Achieve Objectives: In addition to strategies identified under Objectives A.b.2(c)(i-ii), the following strategies would be employed. Livestock grazing would not be permitted on Federal lands along the lower Carson River corridor, except possibly sheep or goats used in an integrated pest management plan to control undesirable invasive vegetation. Prescribed burning would be minimized in this habitat, except as part of an integrated pest management plant to control undesirable invasive vegetation.

Monitoring Elements: Relative composition of different classes of vegetation (e.g., trees, shrubs, grasses) by habitat types and differentiated by native and nonnative, and composition of residual vegetation.

Uplands (A.b.4(c)):

(i) An overstory of native shrubs in many communities, with some communities having an extensive understory of Indian ricegrass and other native bunchgrasses;
(ii) Extensive amounts of bare soil between shrubs in many communities;
(iii) A build-up of residual plant material from native bunchgrasses and forbs, allowed to accumulate naturally over the years (i.e., not grazed or trampled by livestock, crushed by off-road vehicles, etc.).

Basis of Objectives: The shrub component of native salt desert shrub communities is critical given the estimated low frequency of fire return intervals in this habitat type; the spread of cheatgrass threatens this element in some areas of the refuge. Extensive bare soil is also characteristic of these habitats, and cheatgrass and other introduced annuals appear to be detracting from this in many areas. Indian ricegrass is a keystone species, having the potential to greatly influence wildlife diversity.

Strategies to Achieve Objectives: Natural processes in upland areas would be allowed to operate unabated, except possibly efforts to control nonnative vegetation (e.g., cheatgrass), suppress fires (fire was a rare event under natural conditions, but cheatgrass has the potential to alter this significantly), and possibly efforts to facilitate recolonization of areas by Indian ricegrass and other native bunchgrasses. The Agricultural Research Service, Reno, University of Nevada-Reno, and other institutions would be consulted.

Livestock grazing would not be permitted in salt desert shrub habitats, dunes, or other upland areas, and traveling off road by off-road vehicles, bicycles, and horses would be prohibited in these areas to reduce trampling and compaction of vegetation and to reduce the risk of dispersing seeds of nonnative vegetation.

The dune system would be assessed as a potential Research Natural Area (RNA), and, depending on the results of the assessment, it could be recommended for designation as an RNA (Maps 3.6 and 3.7). Wildlife, habitat, and archaeological values would be assessed.

Monitoring Elements: Distribution and acreage of upland habitat types including sand dunes. Relative composition by plant class (e.g., shrub, bunchgrass, annual grass) within plant communities and habitats.

Objective A.b.5: Approximate water chemistry conditions that occured naturally in Stillwater Marsh and the lower Carson River and its delta, according to location of wetland-habitat (i.e., freshwater in riverine and the upper end of the marsh, and brackish at the lower end of marsh), in a way that contributes toward the approximation and maintenance of the natural extent, distribution, composition, and structure of plant and animal communities.

Objective A.b.5(a): Maintain the lowest possible total dissolved solids levels in all upper Stillwater Marsh (generally <600 mg/L during February-June and <1,000 mg/L during the remainder of the year) and portions of the mid and lower Stillwater marsh that are within the flow route of water through the wetland units (<5,000 mg/L); and simulate other key hydrologic factors of the natural marsh such as large volumes of water flowing through the marsh. Wetlands lower down in the system and and off-channel areas would at times have much higher levels of total dissolved solids, possibly approaching 100,000 mg/L in some locations.

Basis of Objectives: Simulating natural water conditions is one of the most important elements of approximating a natural diversity of fish, wildlife, and plants, given the relatively high level of information available on this component of the ecosystem and the comparatively low amount of information on habitat conditions and wildlife diversity. This objective is also based on the assumption that hydrologic functioning is one of the most critical factor that influences habitat and wildlife diversity in wetland systems. Focus of water chemistry objectives is on the upper wetland units in Stillwater Marsh because this is where water generally enters the marsh, fresh-water habitats would be produced in these units, and progressively more saline and alkaline habitats would be produced down gradient of these units. Achievement of these objectives depends on completion of the water rights acquisition program (e.g., acquisition of 42,000 acre-feet of water rights for Stillwater NWR in addition to leasing of water rights during low water years).

Strategies to Achieve Objectives: The following strategies would be carried out to contribute toward achieving these objectives. The main strategy would be the completion of the ongoing water-rights acquisition program, which would contribute most significantly toward achieving objectives. Drainwater and water from groundwater pumping would be mixed with irrigation-quality water. Flushing flows through the marsh would be maximized during precautionary releases and spills from Lahontan Reservoir by implementing strategies described previously to flush salts and other dissolved solids. Large volumes of water would be delivered during relatively short periods of time to the extent possible, as prescribed under strategies described above.

Stillwater Point Reservoir would be used to store water to be delivered to other parts of the marsh at strategic times to more closely approximate natural inflow patterns and for other objectives; the Service would work with the Bureau of Reclamation and TCID to use Harmon Reservoir, S-Line Reservoir, and possibly Sheckler Reservoir (with modification) to store water for delivery to the refuge, when necessary, during December to early March.

To accommodate the delivery of larger volumes of water, to allow larger volumes of water to flow through the marsh during precautionary releases and spills from Lahontan

Reservoir, the following strategies would be undertaken. Water-control structures, internal canals, and other facilities would be modified to accommodate 750-850 cubic-feet per second (cfs) or more from the upper end of the refuge (Stillwater Point Reservoir, West Canal, etc.) through Pintail Bay and/or Big Water into the Carson Sink. The West Canal would be enlarged (to accommodate up to 250 or 300 cfs) and extended to West Marsh. East and Center Canals would be enlarged to accommodate 250 cfs each, and water control structures and conveyance between wetland units would be enlarged to accommodate significantly higher flows. During peak flows in any given year, water flow would be concentrated in one pathway to the extent possible, although this could change among years. Modifications to infrastructure would account for continued inflow of up to 120 cfs from the D-Line Canal at the northwest end of Stillwater Marsh. Other alterations to the system to allow for more independent management of wetland units would include extending the Goose Lake Bypass Canal.

The need for small units, such as Swan Check, given refuge goals and purposes, would be evaluated and eliminated where deemed nonessential (the more units there are, the more potential constrictions). Options for outlets of Pintail Bay and/or Big Water to the Carson Sink would be analyzed and designed in a way that these units would not restrict the amount of water that can be conveyed into and through the historic marsh. The Service would work with Department of the Interior, Bureau of Reclamation, and TCID to analyze options for increasing the capacity of delivery canals leading to Stillwater Point Reservoir and West Canal in order to accommodate flows of at least 750 cfs from the southern end of Stillwater NWR.

Water management strategies would be undertaken in a way that maximizes the volume of flow-per-surface acre of wetland-habitat to more closely approximate natural flow rates through the marsh, which can be accomplished in part by: (1) limiting peak wetland acreage to about 18,000 acres, to the extent possible even in spill years, unless the volume of excess water exceeds 150,000 acre-feet (AF) (i.e., flood no more wetlands than necessary to prevent damage to the infrastructure); (2) modifying the infrastructure to allow a flow-rate of at least 500 cfs through the marsh without the use of bypass canals, which likely would require the construction of spillways between units in addition to enlarged water-control structures; (3) conveying water from unit to unit in the historic marsh during precautionary releases and spills, only using bypass canals when this is needed to avert damage to the infrastructure; and (4) concentrating the majority of the flow through one chain of units in the historic marsh , which may require spillways in addition to enlarged water-control structures.

Monitoring Elements: Specific conductance, pH, turbidity, and dissolved oxygen would be monitored monthly in major wetland units, water delivery canals (both on and off the refuge), and major drains entering the refuge.

Objective A.b.5(b): Manage wetlands water on Stillwater NWR to maintain concentrations of potentially toxic trace elements below effect levels, identified below, while recognizing that maintaining concentrations below these levels in the refuge's wetlands may not be attainable in all wetland units (e.g., wetlands lower on the hydrologic gradient) at all times of year (e.g., later in the summer when wetland-habitat acreage shrinks), or during all time periods (e.g., regional drought conditions).

Fish and wildlife concern and effect concentrations for contaminants of concern on Stillwater National Wildlife Refuge, Churchill County, Nevada.

constiuent	effect concentration[a]	concern concentration[a]	reference[b]
ammonia (mg/L)	0.4	0.04	1
arsenic (µg/L)	40	-	2
boron (µg/L)	1,016	200	3, 4
copper (µg/L)	10	5	6
lead (µg/L)	3.5	1.0	7, 8
mercury (µg/L)	0.1	0.0006	9
molybdenum (µg/L)	790	28	5
selenium (µg/L)	3.0	1.0	10
zinc (µg/L)	32	-	11

[a] Effect were identified as such in literature or were associated with a major adverse effect (i.e., mortality), concern concentrations were identified as such in literature or were associated with non-lethal effects (i.e., reduce growth).

[b] 1, Russo (1985); 2, U.S. EPA (1985a); 3, Birge and Black (1977); 4, Birge et al. (1979b); 5, Eisler (1997); 7, U.S. EPA (1985b); 8, Wong et al. (1981); 9, Schwarzbach (1998); 10, Skorupa (1998), 11, U.S. EPA (1987)

Basis of Objectives: A variety of environmental contaminants have been identified in water, sediment, and biological tissues on Stillwater NWR, as identified above. Elevated contaminant concentrations have the potential to compromise attainment of other refuge objectives, including restoration of natural biological diversity, maintenance of high-quality habitat, and production of waterbirds. Effect concentrations were so noted in published literature or were associated significant toxic effects to fish and wildlife, such as substantial mortality, reduced production, or teratogenesis. Concern concentrations were so noted in published literature or were associated with less severe observable effects, such as low-level mortality or decreased growth for limited time periods. The attainment of objectives for water chemistry, sediment, and biological tissues, as provided in the above table, would minimize the potential for contaminants to compromise other refuge objectives.

Strategies to Achieve Objectives: As discussed under Objective A.b.5(a), the acquisition of water, the management of drainwater, and regular flushing of marshes are expected to reduce concerns with dissolved solids. As such, it is anticipated that concerns with trace elements closely associated with dissolved solids, such as arsenic and boron, would also be reduced.

Previous sampling has demonstrated that the chemical quality of water varies with water delivery routes. The Service would continue to monitor water quality parameters in delivered water and review water quality data collected by other entities to identify those routes through which the water with the lowest concentrations of TDS and trace elements can be delivered. Use of routes providing the lowest concentrations of these elements would be emphasized, while use of routes providing water with higher concentrations of these elements would be de-emphasized.

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Pesticides have been identified as a concern on Stillwater NWR. The Service (Nevada Fish and Wildlife Office) would conduct a review of pesticide use in Lahontan Valley and continue to review water quality data to determine extent and severity of concerns with pesticides. If deemed necessary, pesticide residues in major water delivery routes and drains would be monitored. If it is determined that pesticides have the potential to impair the achievement of refuge purposes, the Service would work with TCID and other entities to reduce pesticide transport to the refuge.

The Service would collect additional data to evaluate concerns with nutrients (including ammonia) and bacteria. If nutrients continue to be of concern, the Service would pursue source identification and work with appropriate entities (i.e., Natural Resource, Conservation Service, University of Nevada Cooperative Extension, and Nevada Division of Environmental Protection) to identify measures to reduce concerns with nutrient and bacteria transport to the refuge.

In some cases, exposure to contaminants in sediment and food chains represents the greatest hazard to fish and wildlife on Stillwater NWR. The acquisition of water is expected to reduce the risk with at least some of these contaminants. However, the degree to which concerns may be reduced are uncertain. The Service would continue to monitor contaminant contaminant concentrations in sediment and biological tissues to evaluate contaminant risk in wetlands and associated wildlife. Additional measures to reduce risk may be developed if warranted.

Monitoring Elements: Monthly concentrations of TDS through measurements of specific conductance, pH, turbidity, and dissolved oxygen. Water samples would be collected quarterly from major water delivery routes for analysis of total dissolved solids, major ions, nutrients, trace elements, and bacteria. To the extent possible, water quality data collected by other agencies would be used. If warranted, samples would be collected for pesticide analyses during periods of peak pesticide use. Monitoring of trace element concentrations in water, sediment, and biological tissues from selected Stillwater NWR wetlands every three years.

Objective A.b.5(c): Minimize the amount of mercury entering Stillwater NWR wetlands and reduce mercury levels in wetland sediments and biological tissues to non-hazardous levels.

Basis of Objective: Mercury has the potential to impair the Service's ability to achieve refuge goals and purposes.

Strategies to Achieve Objectives: The amount of mercury entering the Stillwater NWR wetlands would be minimized and mercury in wetland sediments and biological tissues would be reduced to non-hazardous levels. Through cooperation with the EPA and the Ecological Services office of the Fish and Wildlife Service in Reno, the most appropriate means to reduce mercury concentrations and avoid any increased distribution of mercury contamination would be determined, and an operational plan would be developed and implemented. To assist in these efforts, the Service and EPA anticipate the development of a model to increase the understanding of mercury dynamics in Lahontan Valley wetlands. Some potential remedial considerations include: (1) avoiding the use of certain water delivery routes to the refuge; (2) evaluating the benefits and possible detriments of using precautionary releases and spills from Lahontan Reservoir; (3) using cattail stands to filter water entering the refuge; (4) de-emphasis of management of contaminated wetlands; (3) working with Bureau of Reclamation, TCID, and EPA to identify and explore options of conducting releases from Lahontan Reservoir for deliveries and for precautionary releases that would minimize transport of mercury from Lahontan Reservoir; and (5) implementation of measures to reduce the biological availability of mercury.

Monitoring Elements: Mercury loading in various locations throughout the marsh and riparian areas.

Subgoal A.c: Allow and provide for natural types, levels, rates, and distributions of biotic processes, such as herbivory, granivory, predation, population fluctuations of resident wildlife, and production; minimize or exclude processes not natural to the area or that are above or outside the levels, rates, locations, or communities that would occur naturally. Exceptions to this include: (1) diseases such as botulism and cholera, which would be minimized; and (2) browsing by deer and other wildlife may be controlled, to allow the reestablishment of native vegetation.

Objective A.c.1: Prevent grazing and browsing by nonnative herbivores above natural levels (use and distribution) for any given plant species and community, and season for these species and communities, and prevent fires in upland areas except as prescribed.

Basis of Objectives: One of the major elements of natural biological diversity is the natural operation of biotic processes. Cattle herbivory has resulted in unnaturally high rates of grazing and browsing in many habitats on the refuge. Furthermore, excessive grazing and browsing by cattle would continue to impair restoration of many of the refuge's plant communities and associated wildlife (Appendix M).

Strategies to Achieve Objectives: As part of an effort to approximate natural levels, distributions, and rates of natural biotic processes, livestock grazing would be excluded from all areas of the refuge except where needed to achieve specific habitat objectives for particular wildlife species. Natural succession rates would be fostered by allowing vegetation to progress to late seral stages of succession undisturbed by livestock grazing or burning in designated areas of the refuge. This would require fencing along the external boundary and a number of inholdings.

Natural processes in upland areas would be allowed to operate unabated, except efforts to control nonnative vegetation (e.g., cheatgrass) and suppress fires (fire was a rare event under natural conditions, but cheatgrass has potential to alter this significantly).

Monitoring Elements: Acreage protected through fencing, upland plant community composition; distribution, acreage, and the frequency and timing of fires.

Objective A.c.2: Allow native herbivores to graze and browse at natural levels (use and distribution).

Basis of Objectives: Same as above. Also, muskrats are a natural part of the marsh ecosystem and have influenced marsh vegetation dynamics for many thousands of years.

Strategies to Achieve Objectives: Muskrats would be allowed to graze unabated on emergent vegetation. However, the following factors would be considered: (1) muskrat control measures may be necessary while emergent vegetation is recovering in some units, or possibly to avoid over grazing by the muskrats if this is deemed undesirable; (2) muskrat control may be needed along dikes — in these cases, muskrats would not be trapped further than 100 feet from dikes; and (3) a study would be initiated to examine the relationships between muskrats and marsh ecology, to ascertain whether environmental conditions would allow muskrat populations to reach deleterious levels (part of the study may involve allowing the population to climb without any control to see what happens to the habitat and population). The study would include a review of existing literature on muskrat management. Any muskrat control program would recognize their natural role in the wetland ecosystem.

Monitoring Elements: Acreage of deep-emergent vegetation, muskrat lodge index, outside research to elucidate muskrat/marsh interactions specific to Stillwater Marsh.

Objective A.c.3: Prevent depredation of nests above natural levels when caused by unnaturally high populations of predators. (This objective does not include taking action when other factors are causing unnaturally high depredation rates, such as lowered habitat quality.)

Basis of Objectives: It has been surmised that the common raven population is well in excess of natural levels and that this is causing excessive nest depredation in many waterbird species.

Strategies to Achieve Objectives: Natural predation rates would be studied to gain better understanding of: (1) the role of common ravens, coyotes, and other predatory species in a naturally functioning system, (2) changes in predator populations (especially ravens) from pre-Euro-American settlement to present, (3) changes in the production of migratory waterbirds from pre-Euro-American settlement to present, and (4) relationships between changes in predator populations and changes in waterbird production, including assessments of changes in habitat conditions, human disturbance, and other factors that could potentially affect production. In addition to addressing the above factors, the information would be used to identify triggering mechanisms. Under this alternative, a predator control program would recognize the natural role that predators play in the refuge ecosystem. Furthermore, non-lethal techniques would be of highest priority, including the elimination of poles, spoil piles, and other perches near waterbird nesting locations, and egg aversion methods. However, if production of a species of special concern was considerably impaired by predation or nest depredation, a targeted program to resolve the immediate threat would be designed and implemented with the appropriate level of NEPA documentation. The least invasive technique available would be used in all such control efforts.

Monitoring Elements: These would include production levels and nest depredation rates for selected species, and spring populations of common ravens and coyotes, but factors to consider would be further refined through research.

Objective A.c.4: Prevent human disturbances that would materially affect the use of the refuge by native wildlife, nest success of waterbirds and riparian birds, overall production, daily activity patterns of birds, use of important feeding habitats by waterbirds during migration and winter and the nutritional status of these birds, and other biotic processes.

Objective A.c.4(a): Maintain a minimum of 60 percent of the refuge's wetland-habitat in areas providing relatively secure habitat (e.g., free from boat traffic, walk-in-only areas, sanctuary), combined, such that (i) the full range of life-history requirements of all major waterbird guilds are contained in the selected areas; (ii) a minimum of 4,000 acres are in sanctuary (no public access), and (iii) the "other secure areas" provide relatively secure feeding, resting, and breeding habitat for waterbirds.

Objective A.c.4(b): Minimize public use impacts to wildlife in areas outside the sanctuary while still providing opportunities for compatible wildlife-dependent recreation.

Basis of Objectives: The presence of people and human activity can, depending on a variety of factors heavily influence the distribution, behavior, health, production, and survival of wildlife. This has the potential to impair the Service's ability to achieve refuge goals. However, given the desire by the Service to encourage more people to learn about the marsh, its wildlife, and wildlife conservation issues (another refuge goal), it is imperative that this is done in a way that minimizes adverse impacts to wildlife.

Providing areas for wildlife where the density of refuge visitors is low or nonexistent would ensure that birds have a place to rest, feed, and find shelter from the weather in an area where they won't be flushed or otherwise disturbed by people. Providing a "core reserve" (or sanctuary) is a fundamental principle of conserving natural biological diversity. These objectives link the wildlife-related goals and the public use goal of the refuge.

Strategies to Achieve the Objective: Several requirements would be implemented under Alternative C to minimize adverse impacts associated with human activity in wildlife habitat. A minimum of 4,000 acres of the refuge's wetland-habitat would be maintained in sanctuary status year-round[A]. During the nonhunting season, access in the vicinity of wetlands would be limited to open roads and trails except in designated areas. New observation areas, trails, and other developed sites would be located and managed to minimize adverse impacts to wildlife. Two options would be considered to minimize adverse impacts associated with human activities during the waterfowl hunting season. Although the acreage of wetland-habitat would vary through the hunting season and from season to season, the actual boundaries of the sanctuary, hunt area, and walk-in-only hunt area (Option 2) would not change (Maps 3.6 and 3.7; located in the public-use management section).

Option 1. During the hunting season, water would be apportioned in the following way:

- the first 4,000 acres[A] of wetland-habitat would be maintained in the sanctuary;
- the next 3,000 acres of wetland-habitat would be maintained in the hunt area; and
- each additional 2,000 acres would be distributed as follows, in this order:
  - general public use area (500 acres),
  - sanctuary (500 acres), and
  - hunt area (1,000 acres).

The following units would be maintained as year-round sanctuary: West Marsh, Lead Lake, Stillwater Point Reservoir (except immediately adjacent to the wildlife viewing site and boardwalk), Upper Foxtail Lake, the southern two-thirds of Lower Foxtail Lake, and Dry Lake (Map 3.6). No public access would be permitted in these units year-round. The amount of wetland-habitat available for flooding in the sanctuary would be about 7,300 acres under this alternative. Areas open for wildlife viewing would provide additional areas that would provide at least some level of security for hunted species of birds.

Option 2. During the hunting season, water would be apportioned in the following way:

- the first 4,000 acres[A] of wetland-habitat would be maintained in the sanctuary;
- each additional 5,500 acres would be distributed as follows, in this order:
  - general hunt area (2,500 acres),
  - walk-in-only area (2,500 acres), and
  - sanctuary (500 acres).

The following units would be maintained as year-round sanctuary: Stillwater Point Reservoir (except immediately adjacent to the wildlife viewing site and boardwalk), Lower Foxtail Lake, Doghead Lake, Dry Lake, Cattail Lake, Division Pond, and East Alkali Lake (Map 3.7). No public access would be permitted in these units throughout the year. The amount of wetlands available for flooding in the sanctuary would be about 4,500 acres under this alternative. Additionally, West Marsh and Swan Lake would be maintained as walk-in-only areas during the hunting season. Once the sanctuary and walk-in-only area is filled, all additional acreage would go to the general hunt area.

During the hunting season, walk-in-only access into West Marsh and Swan Lake would entail closing North Road and Willow Dike Road, and exclude all watercraft and mechanized forms of travel and gear portage. Additional restrictions may be added (e.g., a permit system) if monitoring reveals that the walk-in-only hunt area is not accomplishing the objectives for which is was designed.

Under both options, the Carson River corridor south of Wolf Dam (Federal lands only) and the Carson River from the southern limit of Section 30 (Timber Lake area) north to, and including, the delta wetlands in the "Fallon Unit"[1]. Recreation in these areas would be managed to minimize adverse impacts to wildlife. The Carson River delta is anticipated to provide less than 100 acres of wetland-habitat during the fall and winter except on rare occasions.

In years when less than 4,000 acres of wetland-habitat would be provided during the hunting season, hunting would not be permitted[A] and the 4,000 acres could be provided anywhere on the refuge (so as not to limit wetland-habitat to the areas designated as sanctuary). A monitoring program would be designed to assess the effectiveness of maintaining disturbance below acceptable levels. The monitoring program would include success criteria and triggering mechanisms.

The three major sources of impacts from boating, with respect to disturbing wildlife, are: noise, speed, and access. The latter two can also result in adverse impacts to cultural resources. Boating regulations to minimize these elements of disturbance to wildlife and cultural resources would be developed and implemented. These regulations would include: (1) prohibiting all watercraft (including float-tubes) on the refuge from March 1 through August 1; (2) limiting boating during the two periods, August 1 through the onset of waterfowl hunting season and the end of waterfowl hunting season through February 28, to nonmotorized boats and boats powered by electric motors; and (3) limiting boating during the waterfowl hunting season to boats with motors of less than 15 horsepower (higher than what is now identified in the refuge brochure), and less than 5 miles-per-hour. The intent of this horsepower and speed restriction is to minimize noise and speed of boats to the greatest extent possible (as these have the highest potential for impacting birds) while still providing reasonable access to the marsh. An exception under Option 1 would be Goose Lake, in which one or two canoe trails would be developed and maintained for wildlife observation and environmental education during the nonhunting season. Goose Lake would be closed to motorized boats during the hunting season. An exception under Option 2 would be a year-round closure to motorized boats in Lead Lake.

Further protection from human disturbance would be provided by: (1) limiting land-based vehicles to roads, parking areas, and vehicle pullouts; and (2) maintaining road closures to some portions of wetland units in public-use areas (i.e., no land-based vehicle access), including seasonal closures. Service activities would be conducted in such a way that they minimize adverse impacts to wildlife, while still allowing sufficient access to accomplish the goals and objectives of the refuge. To minimize disturbance to upland wildlife species, off-road vehicles, bicycles, and horseback riding would be restricted to open roads only.

The West Pasture unit could also be used as a moist-soil units to enhance habitat quality within the sanctuary, which would provide additional food for dabbling ducks. Foods that currently do not grow in the existing sanctuary could be produced.

A monitoring program would be designed to assess effectiveness of maintaining disturbances and their effects below acceptable levels. The monitoring program would include success criteria and triggering mechanisms.

[A] To mitigate possible adverse impacts to waterfowl hunting opportunities in the near term (due to the restrictions identified above), the minimum sanctuary size would be phased in over a period of six years. For the first three years, the minimum sanctuary size would be 2,500 acres of wetland-habitat, followed by another three years in which the minimum sanctuary size would be 3,500 acres. After six years, the minimum sanctuary size would be increased to 4,000 acres.

Monitoring Elements: Wetland-habitat acreage inside sanctuary, walk-in-only area, and other public use area, by season; distribution and use of habitats by waterbirds; other measures to assess disturbance; and distribution and density of refuge visitors, by activity and season (from public-use monitoring program).

Subgoal A.d: Fill information gaps with knowledge gained through monitoring, management studies, and research (including archaeological and paleoenvironmental investigations, and assessment of historical records), and assess the effectiveness of management actions and identify needed modifications to the management program. Key information items are as follows.

Objective A.d.1: Within five years, estimate the natural, relative level of abundance of all native species of fish and wildlife within Stillwater NWR (e.g., rare, accidental, uncommon, common, abundant), including natural variability over time.

Objective A.d.2: Design management studies and modify the monitoring program, as needed, to ensure that major components of biodiversity, including key taxa of wildlife and vegetation diversity, are being adequately monitored and to evaluate the effectiveness of management actions undertaken by the Service.

Objective A.d.3: Design and implement baseline inventories of birds, amphibians, aquatic and terrestrial invertebrates (e.g., butterflies), and plants within three years along the lower Carson River and its delta, Stillwater Slough, dunes, and nearby salt desert shrub areas to provide baseline information to assess the effects of habitat restoration efforts, including exclusion of cattle from riparian and upland areas.

Objective A.d.4: Estimate the natural geomorphology, hydrology, and habitat composition of the lower Carson River and its delta in the Battleground area, in a way that recognizes natural year-to-year variations.

Objective A.d.5: Estimate the natural composition, structure, and distribution of upland plant communities, and design and implement an inventory to determine the existing conditions of these parameters.

Objective A.d.6: Assess whether the adopted sanctuary and other areas managed to provide security for waterbirds are of sufficient size, encompasses adequate breeding habitat for waterbirds and feeding and loafing habitat for migrating and wintering waterfowl; and whether an adequate amount of secure habitat is provided in the walk-in only hunt area of Option C2.

Objective A.d.7: Research ways to provide wetland-unit drawdowns during July-September in ways that mimic natural water-level declines and that accomplish habitat objectives, but do not contribute to significant avian botulism outbreaks (adapted from Nevada Partners in Flight Plan).

Objective A.d.8: Investigate the habitat needs, especially nesting habitat, of snowy plovers.

Objective A.d.9: Participate in the comprehensive state-wide survey of potential nesting sites of black terns using professional and volunteer personnel, as well as conduct an assessment of the role that Stillwater Marsh played in black tern ecology in the Great Basin (from Nevada Partners in Flight Plan).

Objective A.d.10: Conduct an inventory of the fish occurring on the refuge, with an emphasis on determining the status of Lahontan red shiner and speckled dace.

Objective A.d.11: Ascertain whether Nevada viceroys and Carson wandering skippers (butterflies) inhabit Stillwater NWR, and determine more precisely their habitat requirements.

Basis of Objectives: Additional information is needed to achieve refuge goals, subgoals, and objectives, and to assess the effects of Alternative C on particular species. Some of the objectives were adopted from the Nevada Partners in Flight Plan (e.g., A.d.7-9), and would also contribute to approximating a natural diversity of wildlife.
Strategies to Achieve Objectives: Specific strategies would be outlined in a biological monitoring program (Appendix D).
Monitoring Elements: Completion of investigations and tracking of monitoring efforts.

Goal B: Contribute toward fulfilling obligations of international treaties and other international agreements with respect to fish and wildlife.

Subgoals fully addressed under Goal A: *The following subgoals pertaining to international treaty obligations would be achieved to the extent that the subgoals and objectives of Goal A are accomplished.*

Subgoal B.a: Prevent and abate pollution and detrimental alterations of habitats of native plants and animals, including (1) preventing the introduction of nonnative plants and animals, (2) preventing the spread of introduced species that have become established, and (3) eradicate, to the extent possible, existing populations of nuisance species.

Basis of Subgoal: Preventing and abating pollution and the detrimental alteration of habitats and ecosystems is identified in this objective are identified as obligations of the United States and other contracting parties in several international treaties (migratory bird treaty with the [former] Soviet Union, The Convention on Biological Diversity). The Convention on Biological Diversity further obligates contracting parties to prevent the introduction of, and control species that threaten ecosystems, habitats, or species.
Strategies to Subgoal: See strategies under Objectives A.a.3, A.b.3(b)(c), and A.b.4(b).
Monitoring Elements: See monitoring elements under these objectives.

Subgoal B.b: Restore, preserve, and conserve natural ecosystems and habitats for migratory birds, other animals, plants, other components of biodiversity, and for the protection and conservation of natural areas.

Basis of Subgoal: The target of this objective is a common theme of several international treaties (Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, Convention on Protection of World Culture and Natural Heritage, the migratory bird treaty with the [former] Soviet Union, Convention on Biological Diversity)
Strategies to Subgoal: See objectives and strategies under Goal A.
Monitoring Elements: See monitoring elements under Goal A.

Subgoal B.c: Ensure that public use does not detract from the Service's ability to achieve wildlife-related refuge purposes and that it is consistent with conservation and sustainable use principles; and ensure that sufficient sanctuary is provided for waterfowl using the Lahontan Valley, which may require additional study.

Basis of Subgoal: Several international treaties contain provisions to ensure that contracting parties (e.g., the United States) manage public uses within protected areas (e.g., refuges and reserves) in a way that is compatible with the purposes for which they were established (Convention on Biological Diversity, Convention on the Wetlands of International Importance, Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere). The migratory bird treaties with Mexico and Japan obligate the United States to establish no hunt zones and sanctuaries for migratory birds. Additional rationale for this objective is provided under Objective A.c.4.
Strategies to Subgoal: See strategies under Objectives A.c.4.
Monitoring Elements: See monitoring elements under Objectives A.c.4.

Subgoals not fully addressed under Goal A: *The following subgoals and objectives are additions that may be necessary to address international agreements addressing fish and wildlife conservation (e.g., Western Hemispheric Shorebird Reserve Network and international bird conservation plans). They supplement the objectives listed under Goal A, but would result in no more than minor deviations from the objectives and strategies outlined under Goal A. The following subgoals, objectives, and strategies were developed in consideration of the goals, objectives, strategies, and actions outlined in the Intermountain West Joint Venture Plan (Intermountain West Joint Venture 1995), Nevada Partners in Flight Plan (Partners in Flight 1999), and the U.S. Shorebird Conservation Plan, Intermountain West Region Report (Oring and Neel 1999), hereafter referenced as the Intermountain West Shorebird Conservation Plan.*

Subgoal B.d: Provide for the needs of migrating and breeding shorebirds as part of the Western Hemispheric Shorebird Reserve Network in ways that are consistent with the overall approach prescribed under Goal A.

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Objective B.d.1: Provide high-quality nesting and brood-rearing habitat for shorebirds, in consideration of habitat availability in other parts of the Lahontan Valley and throughout the Interior Basins ecoregion.

Basis of Objectives: Stillwater Marsh and other wetlands in the Lahontan Valley are components of the Western Hemispheric Shorebird Reserve Network, meaning that the Service should make a diligent effort to contribute to this international effort to conserve shorebird populations. In some years the Lahontan Valley wetlands provide stopover habitat for about half of North American's population of long-billed dowitchers, and Stillwater NWR is a key area for snowy plovers, a species of special concern. Providing high-quality habitat for shorebirds would also contribute toward accomplishment of goals and objectives of the U.S. Shorebird Management Plan and Nevada Partners in Flight Plan, two international planning efforts. The Convention on Wetlands of International Importance calls for contracting parties to endeavor to increase waterbird populations on appropriate wetlands.

Strategies to Achieve Objectives: It is anticipated that this objective would be accomplished through the achievement of objectives under Goal A, especially the objective to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. Carrying out the strategies outlined under Goal A would also contribute to the habitat goal for marshes and lakes in the Intermountain West Shorebird Conservation Plan and the objectives and strategies in the Nevada Partners in Flight Plan for snowy plover and American avocet. Particular attention would be paid to flooding at least one major alkaline playa for snowy plover nesting each year (an action in the Nevada Partners in Flight Plan), see also Objective B.g.2. It is expected that a sufficient amount of flooded saltgrass meadow, submergent vegetation, and other suitable habitats would be provided on Stillwater NWR during the breeding season to adequately contribute toward the Nevada Partners in Flight Plan population objective for American Avocet in the Lahontan Valley, even though a breeding population objective would not be adopted for Stillwater NWR.

To the extent that suitable habitat is not being provided for these species, the Service would consider adjusting wetland management to better provide for their needs. This could possibly include actions identified in the Nevada Partners in Flight Plan that deviate from the approach outlined under Goal A to include maintaining one saltgrass pasture flooded at a constant depth between 2 and 6 inches from April 15 through August 1 (wet meadow communities typically did not remain flooded after mid June). This practice would be further evaluated to determine if it is needed given the expanse of other suitable wetland-habitat that will be available on Stillwater NWR and Carson Lake. Specifically, Carson Lake may provide enough of this habitat for Lahontan Valley. Predator control would generally not be practiced under this alternative, except as described under Objective A.

If production rates are significantly lower than estimated natural production rates for a particular species of shorebird and predation is determined to be the ultimate factor causing reduced production, predator control may be used to enhance shorebird production. A possible exception to this is the snowy plover, due to its low and possibly declining population in Nevada.

Monitoring Elements: Acreage of breeding habitat types, nest production. A shorebird breeding-population survey would be coordinated with other agencies (Nevada Partners in Flight Plan).

Objective B.d.2: Provide high-quality shorebird habitat during spring and fall migration, including rising water levels during spring and declining levels during the late summer and fall.

Basis of Objectives: same as above

Strategies to Achieve Objectives: This objective should be fully met through objectives and strategies under Goal A, given extensive amounts of declining water levels during the late summer and fall and rising water levels during the spring. Nonetheless, monitoring would be undertaken to determine whether adequate habitat is provided to migrating shorebirds at appropriate times. Planning, monitoring, and other aspects of wetland management would be coordinated with the Intermountain West Shorebird Conservation Plan.

To the extent that suitable habitat is not being provided for these species, the Service would consider adjusting wetland management to better provide for their needs. This could possibly include actions identified in the Nevada Partners in Flight Plan that deviates from approach outlined under Goal A to include managing one wetland unit to be in a mature stage of invertebrate growth and gradual drawdown from April 1 through May 10. This practice would be further evaluated to determine if it is needed given the expanse of other suitable wetland-habitat that will be available on Stillwater NWR and Carson Lake at the completion of the water-rights acquisition program. Consideration would be given to the declining springtime water levels at Carson Lake (i.e., rising water levels in Stillwater Marsh could compliment the different water management approach at Carson Lake).

Monitoring Elements: Seasonal acreage of alkali mudflat, moist-soil, and wet meadow wetland habitat types.

Subgoal B.e: Provide high-quality habitat for migrating, breeding, and wintering waterfowl and other birds associated with marshes in ways that are consistent with the overall approach prescribed under Goal A.

Objective B.e.1: Provide high-quality nesting and brood-rearing habitat for waterfowl and other waterbirds.

Basis of Objective: This objective generally falls under the umbrella of contributing to the goals and objectives of the Intermountain West Joint Venture (North American Waterfowl Management Plan). The Lahontan Valley wetlands, including Stillwater NWR, have been identified as one of the focus areas of the Intermountain West Joint Venture, which called for habitat to accommodate a breeding population of at least 2.5 million ducks throughout the Intermountain West.

Strategies to Achieve Objectives: This objective would in large part be accomplished through the achievement of objectives under Goal A, especially the objective to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh and a large volume of water to be delivered in early spring. Shoreline and meadows would provide enhanced nesting habitat for upland nesting species as a result of spring pulses of water flooding saltgrass and mixed meadow grass communities and in some areas through the elimination of cattle grazing in these habitats.

Monitoring would be undertaken to determine whether adequate habitat is provided for nesting waterfowl. This information would then be weighed against other objectives and priorities to determine the appropriate action. In some cases, it may be decided that reduction of extensive stands of rank emergent vegetation should be undertaken to enhance habitat for breeding waterfowl that require openings in vegetation. Methods may include prescribed burning, cattle grazing and trampling, and disking.

Predator control would not be used to enhance waterfowl production, unless production rates are found to be significantly lower than estimated natural production rates for the species and predation is determined to be the ultimate factor causing reduced production. The assumption at present is that habitat conditions are the ultimate factor influencing production rates.

Monitoring Elements: Acreage of meadow and deep emergent nesting-habitat available, structure and height of meadow habitat, pattern of emergent vegetation/open water, numbers of waterfowl breeding pairs.

Objective B.e.2: Provide high-quality habitat for waterfowl during fall and winter, until wetland units ice over (generally late December or January).

Basis of Objectives: The Intermountain West Joint Venture Plan set objectives for providing migrational and staging habitat to support a fall migration of at least 20 million ducks, 60,000 tundra swans, 700 trumpeter swans, and 90,000 geese; and habitat to support a midwinter population of at least 2.5 million ducks and 90,000 geese. Lahontan Valley, including Stillwater NWR, is an emphasis area within the Intermountain West. In many years, up to about 70 percent of the waterfowl migrating and wintering in Nevada, pass through and use Stillwater NWR and other Lahontan Valley wetland areas.

Strategies to Achieve Objectives: This objective would be met through objectives and strategies outlined under Goal A, especially the objective to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. However, few details were provided on one aspect of the fall and winter habitat for waterfowl, that is the flooding of moist soil vegetation during this time period.

In certain wetland units (which may differ from year to year), the process of allowing water levels to decline during the summer would be curtailed in September or October. At this time, water levels in designated units (roughly 1/3 of the refuge units, or an average of about 1/3 of the acreage during October-December) would be slowly raised to flood areas containing seed-producing annual plants, which would provide carbohydrates and fat for the higher maintenance requirements of dabbling duck species during winter and migration.

This process, which would continuously provide new habitat at optimum depths (eight inches or less), would be continued through late fall or early winter. Previously exploited habitat (depleted of seeds) would become deeper while unexploited habitat would become available. An important component of this strategy would be to take advantage of the natural lowering of water levels from June through September (accomplished through previously discussed strategy), which would saturate wetland soils, and would promote germination of annual plants.

West Marsh (Option 1) or West Marsh or Swan Lake (Option 2) would be included in the wetland units to annually receive this treatment. To supplement these units, West and East Pastures would also be flooded during the fall and winter to provide access to moist soil vegetation inside the existing sanctuary.

High water levels would be maintained in a few wetland units into late summer or fall, at which time they would be permitted to decline through late winter or early spring. Wetland units targeted for this approach would be those in the upper marsh containing marked potential for producing aquatic vegetation (e.g., Lower Foxtail). This likely occurred in the upper marsh under natural conditions and would be, in part, undertaken to facilitate feeding by diving ducks and swans.

Upon completion of the water-rights acquisition program (i.e., long-term average of 70,000 acre-feet of water per year), annual water plans would be written to provide a minimum of 10,000 acres of wetland-habitat during October-December to benefit waterfowl and to provide waterfowl hunting opportunities.

The Service would work to provide up to 300 acres of alfalfa, wheat, oats, or other crop for wintering Canada geese. However, water and water rights acquired under subsection 206(a) of Public Law 101-618 would not be used to irrigate crops in the farmland area, except possibly after water-rights have been acquired but before they have been transferred to the wetlands. Because the Service would not acquire additional water rights for use on farmlands or for other agricultural purposes, other sources of water would be needed for these crops, such as temporary transfers by farmers in a cooperative farming program.

Haying, prescribed burning, and livestock grazing would be used to provide the crop vegetation at a low height. Although cattle grazing may be used to enhance goose browse in the farmland area of the refuge, it would not be used for this purpose outside the farmland area. Livestock grazing in any given year would be limited to 500 AUMs for the entire refuge.

Monitoring Elements: Acres and within-unit density of submergent aquatic vegetation available to waterfowl, acres of moist-soil habitat and its quality, acres of farmland cultivated for the purpose of providing goose forage, and the waterfowl response to this acreage would be a measure of habitat effectiveness.

Objective B.e.3: Minimize the occurrence, spread, and severity of botulism and cholera outbreaks.

Basis of Objectives: Waterbird diseases such as type C botulism and fowl cholera have the potential to impact populations of waterbirds using the Stillwater NWR Complex. These diseases are occur seasonally. Cholera typically occurs during winter and botulism during hot summer months. Past die-offs have been as high as 55,000 birds, which resulted from a suspected combination of botulism and cholera. diminish the contribution of Stillwater NWR wetlands to achieving Intermountain West Joint Venture goals and objectives. In addition to direct mortality, waterbird use of refuge wetlands can be severely impacted at this level of effect because control efforts (e.g., use of airboats) tend to push remaining birds into isolated and often less-desirable habitat. Botulism and fowl cholera can diminish the contribution of Stillwater NWR wetlands to achieving Intermountain West Joint Venture goals and objectives.

Strategies to Achieve Objectives: Botulism and cholera monitoring and cleanup would be continued as it has in the past, with botulism patrols initiated by mid-June and continuing into early fall. Wetland units with a history of botulism problems would be identified and targeted for regular airboat patrols, with more frequent patrol efforts initiated as outbreaks are discovered. Fall, winter, and early spring patrols would be conducted in more remote areas such as the Carson Sink and where large concentrations are identified through aerial surveys. Carcasses would be immediately removed from wetland units and sick birds would be transported to the refuge "duck hospital" where rehabilitation would be conducted using fresh uncontaminated water in the holding pen.

To meet other objectives under this alternative, water levels would decline in many wetland units during late summer months through evapotranspiration, which could potentially increase the potential for botulism outbreaks. To address this potential problem, options would be explored to minimize the potential for botulism outbreaks while meeting other objectives requiring drawdowns during July-September (e.g., Objective A.d.7 and Nevada Partners in Flight Plan). Where outbreaks occur, wetland-unit flushing or draining could be used to either dilute contaminated units (through flushing) or to reduce the desirability of the unit to susceptible waterbirds (e.g., through draining the unit). Portable Cristafulli pumps would be used to facilitate wetland-unit draining.

Monitoring Elements: Botulism and cholera occurrence by wetland unit, annual number of waterbirds, by species, that die annually due to botulism and cholera.

Objective B.e.4: Ensure that suitable wetland-habitat is provided for other marsh-dependent species, using white-faced ibis, black terns, white pelicans, Clark's grebes, and short-eared owls as indicator species.

Basis of Objective: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which white-faced ibis, black terns, American white pelicans, Clark's grebes, and short-eared owls were identified as key species. White-faced ibis and black terns are species of special concern. Black terns were once abundant in the Lahontan Valley, but now are uncommon.

Strategies to Achieve Objectives: This objective should be fully met through objectives and strategies under Goal A and Objective B.e.2, especially the objective to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. For example, the conditions produced resulting from the following strategies and actions of the Nevada Partners in Flight Plan would be provided through the implementation of objectives and strategies under Goal A: (a) maintaining constant water levels (12-24 inches) in certain hardstem bulrush units from April 15 through August 15 for white-faced ibis nesting; (b) providing foraging habitat at Stillwater NWR for white pelicans; and (c) maintaining semi-permanent marsh with well-developed emergent and submergent plant communities, abundant populations of small fish, and relatively stable water levels from May 1 through November 15 for Clark's grebes. Monitoring would be undertaken to determine whether adequate habitat is provided for these species. Although objectives would not be established for breeding populations of white-faced ibis as identified in the Nevada Partners in Flight Plan, a minimum threshold may be established.

To the extent that suitable habitat is not being provided for these species, the Service would consider adjusting wetland management to better provide for their needs. This could possibly include actions identified in the Nevada Partners in Flight Plan that are outside the framework of this alternative's management program, such as actively managing nongame fish in Stillwater Marsh for white pelicans (as opposed to relying on fish to respond to enhanced habitat), and maintaining residual stands of emergent marsh vegetation by drying an emergent marsh unit for an extended period to build the vole population such that it is high during the period March 1 through July 1, for short-eared owls. This will happen in many years by default, but it likely cannot be done on an annual basis in this specific habitat type. The need for providing this type of feeding habitat for short-eared owls would be assessed and compared to feeding opportunities in other habitats where voles abound, such as meadows.

Monitoring Elements: Acreage and quality of habitat available to each species for nesting and brood rearing, and waterbird response to the habitat provided (e.g., number of nesting pairs, annual production).

Subgoal B.f: Provide high-quality habitat for migrating and breeding birds in riparian areas and salt desert shrub communities in ways that are consistent with the overall approach prescribed under Goal A.

Objective B.f.1: Provide high-quality habitat for neotropical migratory birds associated with riparian areas in ways that are consistent with the overall approach prescribed under Goal A, using yellow-billed cuckoos, ash-throated flycatchers, blue grosbeaks, yellow-breasted chats, and western bluebirds as indicator species.

Basis of Objectives: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which yellow-billed cuckoos, ash-throated flycatchers, blue grosbeaks, yellow-breasted chats, and western bluebirds were identified as key species pertinent to Stillwater NWR. Yellow-billed cuckoos are species of special concern.

Strategies to Achieve Objectives: This objective should be fully met by carrying out the strategies outlined under Objectives A.b.2(c, d), A.b.3, A.b.4(b), and B.g.1.3. Most if not all of the specific objectives, strategies, and actions identified in the Nevada Partners in Flight Plan for key riparian bird species are consistent with the strategies to be undertaken

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under these objectives. For example, major strategies in the Nevada Partners in Flight Plan are to (1) maintain and increase large contiguous blocks of multi-storied cottonwood-willow forests; (2) maintain and enhance mature stands of cottonwood/willow and buffaloberry , and (3) maintain thriving buffaloberry stands mixed with cottonwood and/or willow stands on lowland river floodplains.

Three related action items listed under these strategies were to control saltcedar and reestablish native plant communities, discourage propagation of Russian olive on lowland floodplains, and avoid removal of buffaloberry. These restoration actions, and more, are emphasized in the strategies of this alternative.

Although the lower Carson River within Stillwater NWR was not identified as a potential site in which to restore cottonwood forests for yellow-billed cuckoo, potential exists to restore suitable cottonwood forests along this portion of the river, which would also provide habitat for yellow-breasted chats. To the extent that suitable habitat is not being provided for these species, the Service would consider adjusting riparian restoration efforts to better provide for their needs.

Additional indicator species would be identified.

Monitoring Elements: Amount (acres, miles) and quality (composition, structure) of restored riparian habitat, and bird response to available habitat (e.g., species richness, relative abundance of representative species).

Objective B.f.2: Provide high-quality habitat for birds associated with salt desert shrub areas in ways that are consistent with the overall approach prescribed under Goal A, using loggerhead shrikes and burrowing owls as indicator species.

Basis of Objectives: This objective generally falls under the umbrella of contributing to the goals and objectives of the Nevada Partners in Flight Plan, in which loggerhead shrikes and burrowing owls were identified as key species pertinent to Stillwater NWR. Loggerhead shrikes are a species of special concern.

Strategies to Achieve Objectives: This objective should be fully met by carrying out the strategies outlined under Objectives A.b.2(e), A.b.3, and A.b.4(c). All of the specific objectives, strategies, and actions identified in the Nevada Partners in Flight Plan for key salt desert shrub bird species are consistent with the strategies to be undertaken under these objectives.

For example, major strategies and actions in the Nevada Partners in Flight Plan, pertinent to Stillwater NWR, are to (a) sustain sufficient acreages of salt desert shrub habitat, with large bush diameters for loggerhead shrikes; (b) encourage the maintenance of healthy, diverse salt desert shrub habitats complete with a healthy Indian ricegrass component supporting a thriving rodent community to benefit burrowing owls; and (c) protect and maintain suitable burrowing habitats and primary burrow providers (e.g., ground squirrels, kit foxes, badgers) because burrowing owls use vacated burrows.

Stillwater NWR, under the Alternative C boundary revision and protective measures for upland habitat, would be an important contribution to these strategies in the Lahontan Valley, identified in the plan as a major population center for loggerhead shrike (defined as productive population that contributes to surrounding populations). To the extent that suitable habitat is not being provided for these or other upland species, the Service would consider adjusting upland habitat restoration efforts to better provide for their needs.

Additional indicator species would be identified, possibly including species of butterflies and dune beetles.

Monitoring Elements: Numbers of acres and assessment of quality (composition, structure) of salt desert shrub habitat, and bird response (species richness, relative abundance of representative species).

Subgoal B.g: Restore, enhance, and protect habitat for threatened and endangered species, species of special concern, and other sensitive, rare, or endemic species inhabiting the refuge.

Basis of Subgoal: The migratory bird treaties with Japan and the [former] Soviet Union, Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, Convention on the Protection of World Culture and Natural Heritage, and Convention on Biological Diversity obligate the United States and other contracting parties to take appropriate measures to provide for the protection and recovery of species endangered with extinction or threatened with becoming endangered. Bald eagles are a federally-listed threatened species and Stillwater NWR would, under Alternative C, contain one of the most important roost sites in western Nevada.

Objective B.g.1: Within the next five years, reestablish, in a way favorable for future roosting by bald eagles (including a suitable distance from areas accessible by the public), cottonwood trees in the Timber Lake area, and reestablish similar stands along other parts of the Carson River as additional lands are acquired.

Basis of Objective: See basis of subgoal. Bald eagles are a federally-listed threatened species and Stillwater NWR would, under Alternative C, contain one of the most important roost sites in Nevada.

Strategies to Achieve Objectives: As part of the effort to reestablish cottonwood communities in riparian areas (Objective A.b.4(b)), emphasis would be placed on first reestablishing cottonwoods in the Timber Lake and other areas that would provide suitable roosting habitat for bald eagles. Assurance would be made that the selected locations are areas that would naturally support cottonwoods.

Monitoring Elements: Number of cottonwood stands of suitable characteristics, number of trees established per stand, and ultimately, the number of bald eagles using the trees.

Objective B.g.2: During the interim until their habitat needs are better delineated, provide shallowly-flooded, unvegetated playa habitat for snowy plover nesting in areas they have used in the past.

Basis of Objectives: The snowy plover is a species of special concern and a species of priority focus in the Nevada Partners in Flight Plan, in which Stillwater NWR (including

areas added to Stillwater NWR under Alternative C) have been identified as an area of special emphasis. Nevada is an important breeding area for the western population of snowy plovers.
Strategies to Achieve Objectives: At least one major alkaline playa would be flooded each year to support snowy plover nesting, and emphasis would be placed on enforcing the no-off-road-vehicle use policy in areas used by snowy plovers for nesting (Nevada Partners in Flight Plan). The nesting habitat needs of snowy plovers would be studied (Objective A.d.8), and periodic censuses would be coordinated with other agencies and groups involved in snowy plover recovery efforts.
Monitoring Elements: Acres and distribution of suitable habitat, response of snowy plovers to habitat provided (e.g., breeding pairs, production).

Objective B.g.3: Within the next five years, reestablish native willow and mesic shrub communities along the Carson River in the Timber Lake area for the benefit of Nevada viceroys and other riparian-shrub species of special concern, and reestablish such communities along other parts of the Carson River as additional lands are acquired and along the Stillwater Slough.

Basis of Objectives: The Nevada viceroy, which is a willow-dependent butterfly, is a species of special concern that has been reported in the Fallon area. Yellow-billed cuckoo, another species of special concern, is dependent on large gallery stands of cottonwoods. Sightings of individual yellow-billed cuckoos have been recently recorded in the Lahontan Valley. Habitat quality along the lower Carson River is low at present for both of these species.
Strategies to Achieve Objectives: Willow and other native shrub communities would be reestablished in riparian areas that would naturally support these communities, as outlined in strategies under Objective A.b.4(b).
Monitoring Elements: Presence or absence of species of special concern and the relative abundance of each.

3.4.C.2.2.2 Public Use Management

Guiding Principles

Public use management would be guided by the following principles. Public use management on Stillwater Refuge would recognize the importance of national wildlife refuges in providing opportunities for compatible wildlife-dependent recreational activities. Wildlife-dependent public uses would be managed to provide a balance between hunting, environmental education and interpretation, wildlife observation, wildlife photography, and scientific research the priority public uses of Stillwater NWR under this alternative. Based on the specific reference to environmental education and research in refuge purposes, and given the lack of facilities on the refuge for these uses, emphasis would be given to locating sites and developing adequate facilities for viable programs.

Public use would be managed in a way that recognizes that wildlife will not prosper without high-quality habitat, and without wildlife, wildlife-dependent uses cannot be sustained on refuges. Wildlife-dependent recreation helps foster stewardship and a connection with the resources, and direction for encouraging wildlife-dependent public uses is clearly spelled out in the Service's vision document "Fulfilling the Promise"(USFWS 1999) in the Refuge Improvement Act. Education is key, and will be a focal point of all facets of the public use program within this alternative. It is through education both on and off-site that the public will gain an understanding of the role of humans within their environment. Through on-site programs demonstrating wildlife needs and requirements, people will learn how to practice proper wildlife-viewing etiquette and the importance of management strategies and techniques. It is through education and interpretation that negative human-wildlife interactions can be minimized, by teaching the reasons behind facility design and why certain methods of observation are adopted.

Outreach will be another key component of the public use program. Little marketing of Stillwater NWR has been done in the past, which has resulted in low visitation numbers. With an increase of awareness through media attention, visitation should increase dramatically.

Objectives and Strategies

Goal C: Provide opportunities for environmental education and wildlife-dependent recreation that are compatible with refuge purposes and the Refuge System mission.

Subgoal C.a: Provide opportunities for high-quality hunting experiences.

Basis of Subgoal: Hunting is a wildlife-oriented recreational activity, and one of the purposes of Stillwater NWR is to provide opportunities for wildlife-oriented recreation. As one of the priority general public uses of the Refuge System, hunting must receive higher consideration during the planning process. The Service is encouraged under the Refuge System Administration Act, as amended, to find ways to allow wildlife-dependent recreation on refuges, primarily because providing these types of opportunities teaches refuge visitors about wildlife ecology, and this ultimately facilitates the conservation mission of the Refuge System.

Objective C.a.1: Provide opportunities in which hunters would have a reasonable chance of success in uncrowded conditions and would meet the needs of a broad spectrum of users.

Basis of Objective: Given Stillwater NWR's location, the landscape and size of wetland units, and the types of opportunities that Stillwater NWR has provided in the past, Stillwater NWR would be well suited for providing uncrowded hunting opportunities where there is a reasonable chance of success. This would be the type of high-quality hunting experience that could be provided at Stillwater NWR.

Strategies to Achieve Objective: Alternative C would continue to maintain hunting as an integral part of the recreation program. Two options would be considered by the Service:

Option 1. The following Stillwater Marsh units would be open to waterfowl hunting during the hunting season: Goose Lake, Nutgrass Lake, Swan Lake, Pintail Bay, Swan Check, and Tule Lake (Map 3.6).

At the completion of the water-rights acquisition program, it is anticipated that at least 4,500 acres (43 percent or more) of the fall and winter wetland-habitat in Stillwater Marsh would be consistently open to waterfowl hunting during nonspill years under this alternative (as high as 5,000 acres). In spill years (one of four years) and years following a spill year, it would be as high as 7,000 acres or more.

Option 2. The following Stillwater Marsh units would be open to waterfowl hunting during the hunting season: Goose Lake, Nutgrass Lake, Swan Lake, Pintail Bay, Swan Check, Tule Lake, West Marsh, and Lead Lake (Map 3.7). West Marsh and Swan Lake would be restricted to foot traffic only, which would provide high-quality, low density hunting opportunities.

At the completion of the water-rights acquisition program, it is anticipated that at least 6,000 acres (57 percent or more) of the fall and winter wetland-habitat in Stillwater Marsh would be open to waterfowl hunting during nonspill years under this alternative (as high as 7,500 acres). In spill years (one of four years) and years following a spill year, it would be as high as 10,500 acres or more.

Under both option, opportunities for waterfowl hunting would also be available along the D-Line Canal between the Indian Lakes area and the existing western boundary of Stillwater NWR. Hunter densities would be monitored in part to maintain relatively low-density hunting opportunities now available on Stillwater NWR. "Uncrowded conditions" would be further defined.

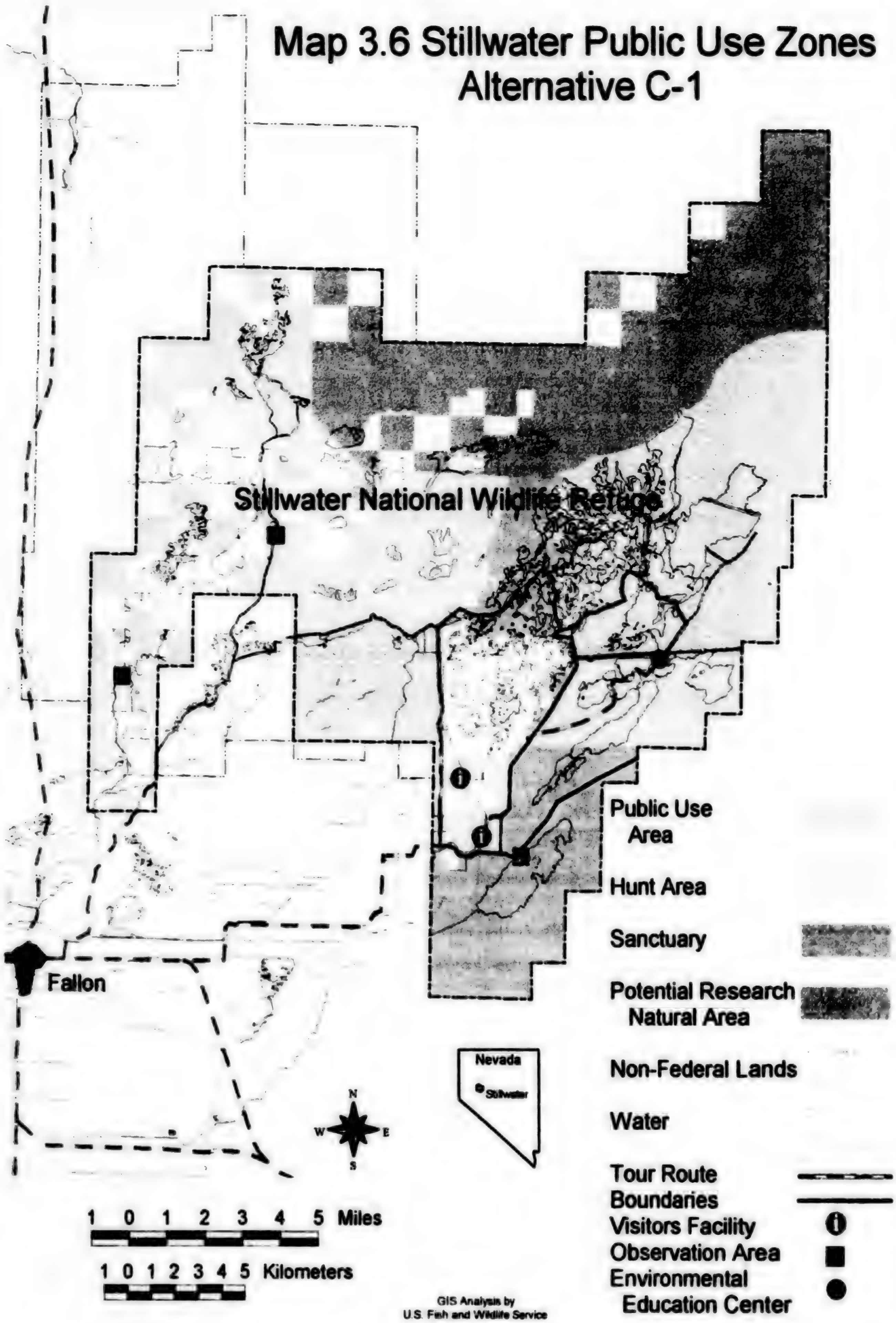
Nonmotorized and motorized water craft with motors of 15 horsepower or smaller (as compared to the 10 horsepower limit currently identified for the refuge) and operated less than 5 miles-per-hout would be allowed in all open hunting areas, except Goose Lake which would be designated as nonmotorized only. Overnight stays would be allowed in designated areas only. These areas would be maintained away from the interior marsh and will contain no amenities such as water or electricity, but restrooms would be provided. A cooperative effort would be sought to provide camping opportunities near the wetlands as described in the Hunting section of Alternative B.

Under this alternative, hunting of California quail in addition to waterfowl, would be allowed during the appropriate season in the hunt area of Stillwater Marsh and along the D-Line canal east of the Indian Lakes area. Lead shot would not be permitted.

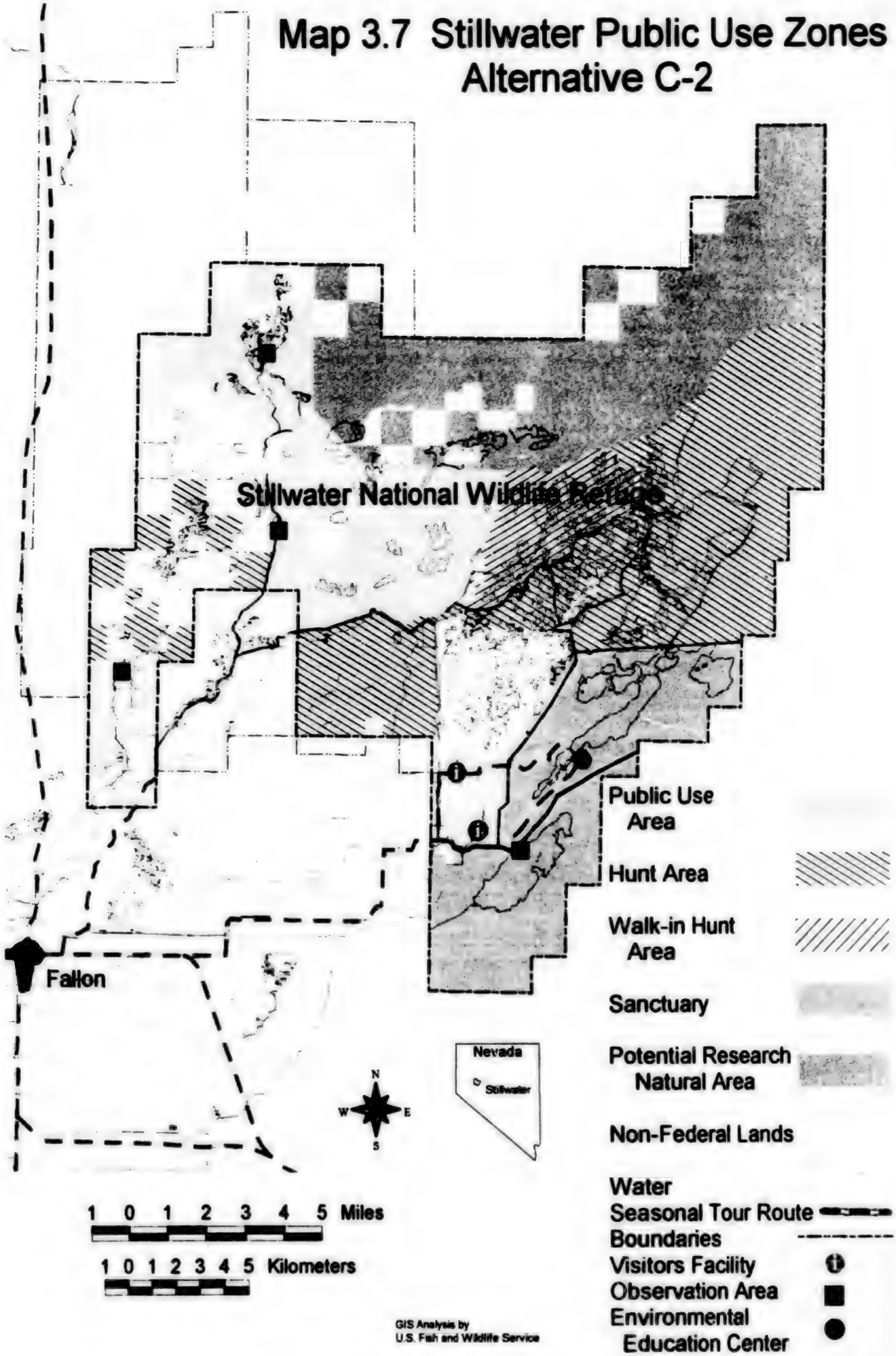
To the extent that lands are acquired along the Carson River corridor between Wolfe Dam and the Timber Lake area (south and west of Township 21 North, Range 30 East), additional opportunities to allow hunting would be explored. At present, very little of this land is owned by the Federal government. If enough land is acquired along this stretch, it would be opened to hunting, pending the completion of a compatibility determination.

Monitoring Elements: Number of hunters, demographics, feedback on the quality of hunting experience.

Map 3.6 Stillwater Public Use Zones
Alternative C-1



Map 3.7 Stillwater Public Use Zones Alternative C-2



GIS Analysis by
U.S. Fish and Wildlife Service

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Objective C.a.2: Ensure that hunting experiences are safe.

Basis of Objective: Beyond being a vital consideration in the management of any public use, the Refuge System Administration Act, as amended, requires that wildlife-dependent recreation be allowed only to the extent that they are consistent with public safety.

Strategies to Achieve Objectives: A limit of 1 hunter per 30 acres would be established for safety purposes. A combined effort between state and Federal agencies would be maintained to provide hunters with sufficient opportunity to attend hunter education courses and ad hoc hunter safety programs. Monitoring hunter density would provide the Refuge Manager with information to determine unsafe conditions.

Monitoring Elements: Number and types of reported and observed injuries per hunting season, observations by staff of unsafe practices and law enforcement infractions.

Subgoal C.b: Provide opportunities for environmental education and interpretation that meet requirements of a broad spectrum of users.

Basis of Subgoal: Providing opportunities for environmental education was specifically identified as one of the purposes of Stillwater NWR. Furthermore, the Refuge System Administration Act encourages the Service to provide opportunities for the priority public uses of the Refuge System. Environmental education and environmental interpretation are two of these six priority public uses. These opportunities are provided in the Refuge System to advance public awareness, understanding, and appreciation of the functioning of ecosystems and the benefits of their conservation to fish, wildlife, and people. This ultimately contributes to the mission of the Refuge System.

Objective C.b.1:.Provide adequate facilities, equipment, and staffing for environmental study and interpretation, including facilities within the nonhunt public-use area of the refuge.

Basis of Objective: Providing adequate facilities and staffing is imperative to providing environmental education and environmental interpretation opportunities to a wide spectrum of users. Service policy requires that environmental education be conducted outside the hunting areas.

Strategies to Achieve Objective: A visitor facility and outdoor classroom would be located on or near the property formerly owned by the Kent family or the Weishaupt family. Restoration of the Stillwater Slough and a demonstration wetland unit would attract waterbirds to the area and support environmental education and interpretation activities. The facility would include a classroom, audio/visual, and interpretive displays. Volunteer docents, with the aid of Service personnel, would supply the bulk of the manpower, and would be well-versed in all aspects of refuge management in order to provide a wide range of information.

The environmental education program would have a mobile component (as in Alternative B) and an environmental education location on-site would be developed. In Option C-1, the educational site would be located at the eastern end of Cattail Lake just off of Division

Road. In Option C-2, development would occur in the southeastern portion of the Upper Foxtail unit. This site would include an area for study, (e.g., a shaded table area) and a small, but permanent, restroom facility. Interpretive signs at this facility would provide information on wildlife and habitat occurring at the site, current Refuge management practices, facilities, and opportunities, and cultural resources to broaden the awareness of a wide range of visitors.

Interpretive kiosks would be designed and placed at the visitor facility and Stillwater Point. These kiosks would provide guidance and information on important natural and cultural features of the surrounding area. Housing for volunteers, temporary staff, and research personnel, as well as a storage facility would be provided to the extent possible. Trailer pads would be made available to accommodate a growing workforce of volunteers.

The property formerly owned by the Alves family would be developed to provide additional opportunities for scientific research and on-site learning. Existing structures would be evaluated for utility and unnecessary structures removed. A kiosk would be designed and constructed to serve as a trailhead to the riparian area along the Carson River. An accessible trail would be designed to facilitate wildlife viewing and photography of riparian species. An accompanying leaflet depicting trail route and location as well as resident and migrant bird species would be developed.

Monitoring Elements: Number, type, and location of facilities, and response by refuge visitors (e.g., number and type of visitor/group using each facility or location).

Objective C.b.2: Provide for the needs of students and teachers and make refuge and Service programs available to them.

Basis of Objectives: Refuges are "learning laboratories" and Service programs are designed to show students and teachers the value of fish and wildlife resources.

Strategies to Achieve Objectives: The environmental education program would be centered around the need to "teach the teachers". A number of comprehensive workshops for local teachers would be developed to demonstrate how to use refuge resources to teach students about conservation issues, specific species and needs, cultural resources, and refuge management. The knowledge gained from Stillwater NWR practices and concerns will aid both teachers and students in understanding the important connections between humans and wildlife.

Monitoring Elements: Number of student and teacher groups per year, assessment of how well their needs/expectations were met.

Objective C.b.3: Provide adequate interpretation of natural and cultural aspects of the area to satisfy the curiosity, and broaden the awareness, of a wide spectrum of visitors.

Basis of Objective: See basis for the subgoal.

Strategies to Achieve Objective: The visitor facility would be staffed to accommodate the majority of visitors during peak use. Volunteers would be trained to answer a wide range of questions about Stillwater NWR, and to provide sufficient background and local information to satisfy the curiosity, and broaden the awareness, of a wide spectrum of visitors. Volunteers would need to be familiar with the refuge infrastructure, as well as the resident and migratory wildlife in the area. Staff would also be well trained in local cultural resources.

Several detailed refuge brochures and leaflets would be developed in compliance with Service graphic standards and distributed through a variety of media resources. The publication would list recreational opportunities and restrictions, as well as provide visitors with information about the refuge and tour route.

The auto tour loop would provide additional interpretation opportunities. High-quality interpretation of fish, wildlife and their habitats, cultural resources, and resource management practices, including placement of information in strategic locations, would increase public awareness, understanding, and appreciation.

Monitoring Elements: Response by refuge visitors; e.g., number of visitors using visitor facilities, number of brochures provided.

Subgoal C.c.: Provide high-quality opportunities for wildlife viewing and photography.

Basis of Subgoal: Providing opportunities for wildlife-oriented recreation is one of the purposes of Stillwater NWR. The Refuge System Administration Act identified wildlife viewing and photography as two of the six wildlife-dependent recreational uses to be facilitated in the Refuge System, and the act encourages the Service to provide opportunities for these uses. When the public is provided opportunities to view and photograph wildlife, plants, and wildlands, awareness, understanding, and appreciation of the ecosystem functioning and the benefits of ecosystem conservation to fish, wildlife, and people will increase. This ultimately contributes to the mission of the Refuge System.

Objective C.c.1: Provide high-quality viewing opportunities throughout the distinctive habitats of the refuge.

Basis of Objective: Providing facilities for viewing wildlife (e.g., roads, pullouts, observation sites) is important for providing high-quality viewing opportunities. Achievement of this objective would provide the public with the opportunity to view wildlife and the relationships between resource management, wildlife and habitat, and people.

Strategies to Achieve Objective: The road between the town of Stillwater and Stillwater Point Reservoir would be paved, and an accessible boardwalk constructed to facilitate viewing of the wetland unit. A self-guided interpretive trail would be developed along the eastern side of the reservoir. Stillwater Point Reservoir is a regulating reservoir for Stillwater NWR wetland units and, as such, water levels can fluctuate widely at times in the reservoir. This results in lower quality wetland-habitat for wetland wildlife. However, due to the ease of access, it is an area that would be useful for the development of facilities to support viewing the marsh and wildlife.

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Two options will be considered under this alternative for a tour loop:

Option 1. An all-weather tour route would be developed, starting from the visitor facility, proceeding north along Hunter Road, then northeasterly, along a road to be constructed, to and between Lower Foxtail and Dry Lake and proceeding between Cattail Lake and Division Pond to Division Road, where the route would turn eastward to the eastern boundary of the refuge and loop into a lookout at the north end of East Alkali Lake. At this point the route would return to Hunter Road (Map3.6). To facilitate viewing along Hunter Road, wetland-habitat would be created and maintained along the east side of the road. A longer tour route, which would be open seasonally, would continue from Division Road north to a road that would be constructed on the spoil bank north of the Lead Lake Bypass Canal for about 1 mile, then continuing west along Center Road and south along West County Road to the visitor facility. The section around Lead Lake would be closed during the hunting season to provide adequate protection for waterfowl.

One or two canoe trails for wildlife observation would be established in Goose Lake, which would be open all year.

Option 2: Under this option, a one-way all-weather tour route would be developed from the visitor facility, transecting Hunter Road and proceeding east along the water delivery canal and veering southeast through a point between Upper and Lower Foxtail Lakes, then southwest along the east side of Upper Foxtail to Stillwater Point Reservoir. From this point, visitors could then exit the refuge via Stillwater Road or could travel north along Hunter Road and return to the visitor facility (Map 3.7). This tour loop, which would make use of existing roads, would be closed to the public during the hunting season. At this time, all or a portion of the tour loop could be opened for guided tours or environmental education classes. The tour loop could also be opened at the Project Leader's discretion during periods of low hunting pressure.

Nonmotorized boating would be allowed year-round in Lead Lake.

Interpretation of refuge resources along the tour route under both options would be accomplished by placing markers at vantage points for viewing wildlife and important habitat, geologic, and cultural features. Cassette tapes and brochures would describe these resources of interest, as well as wildlife that might be seen at the site. Under Option 2, additional kiosks would be strategically located to provide information on local wildlife, vegetation, and cultural resources as well as management practices.

A trail at the Timber Lakes area would be developed to facilitate wildlife viewing and photography. The trail would be designed to minimize disturbance to nesting species during the spring and bald eagle roosting during the winter. This could be done by altering the trail route each season and by providing an interpretive sign that designates the current route and explains why changes and closures are needed.

An accessible trail would be designed along the Carson River near the new refuge entrance to facilitate wildlife viewing and photography of riparian species. An accompanying leaflet depicting trail route and location as well as resident and migrant bird species would be developed.

A looped wildlife-viewing trail would be developed off the west side of the tour loop in the vicinity of Dry Lake, beginning in the upland area, proceeding down to the shore near Dry Lake, then returning to the start point by the tour road in Option 1 (Map 3.6), and in Option 2 (Map 3.7), off the north side of the tour loop overlooking Lower Foxtail.

Monitoring Elements: Number, type, and location of facilities constructed, and response by refuge visitors, e.g., number of visitors using each of the facilities (e.g., tour loop, Dry Lake wildlife-viewing trail, boardwalk) by season.

Objective C.c.2: Provide opportunities for high-quality experiences in wildlife photography.

Basis of Objectives: Providing facilities for viewing wildlife (e.g., roads, pullouts, observation sites) is important for providing high-quality viewing opportunities. Achievement of this objective would provide the public with the opportunity to view wildlife and the relationships between resource management, wildlife and habitat, and people.

Strategies to Achieve Objectives: In addition to strategies under Objective C.c.2, the following would be undertaken specifically for photography. Temporary or permanent photography blinds would be strategically located. Their placement and construction would be done so that the blinds are unobtrusive to provide maximum opportunities. Use of blinds would require a special use permit.

Monitoring Elements: Number, type, and location of facilities constructed, and response by refuge visitors, e.g., number of visitors using each of the facilities (including those under Objective C.c.1) by season.

Subgoal C.d: Encourage and provide opportunities for research by other agencies (e.g., USGS, Agricultural Research Service), universities, and other institutions, especially as they relate to the management goals and objectives of Stillwater NWR.

Basis of Subgoal: As one of the purposes of Stillwater NWR, it is clear that an importance is placed on the need for providing opportunities for scientific research. Furthermore, it is the policy of the Service to encourage and support research and management studies that provide additional scientific data upon which to base decisions regarding management of units of the refuge system (4 RM 6). Research is key to sound resource management.

By providing research opportunities to universities, colleges, and other institutions, the education of students pursuing wildlife, archaeological, or other degrees is enhanced (Subgoal C.b), and the information they provide the refuge on wildlife-habitat relationships, the Cattail-eater culture, and other topics further facilitates environmental education and interpretation (Subgoal C.b) and wildlife conservation (Goals A and B). One of the objectives of supporting research in the Refuge System is to provide students and others with the opportunity to learn the principles of field research (4 RM 6).

Objective C.d.1: Foster relationships with government agencies, conservation groups, and institutions of higher education and communicate the most critical research needs of the refuge.

Basis of Objectives: Subgoal C.d addresses research by non-Service entities, such as other agencies, universities, colleges, and private institutions and organizations. Therefore, communicating this subgoal to these institutions, followed by ongoing coordination, would be important to its achievement.

Strategies to Achieve Objectives: Partnership opportunities would be actively sought, and unsolicited proposals for research in a variety of disciplines would be considered, including wildlife, public use, and cultural resources. All reports, surveys, and scientific papers generated from such endeavors would be made available to refuge staff and cataloged for future needs.

Communicate to these institutions the priority information gaps that the Service is seeking to fill, such as the effects of human activities on wildlife and habitat on Stillwater NWR and other aspects of human and wildlife interactions; the natural composition, structure, and functioning of the lower Carson River and delta ecosystem; and habitat needs of species of special concern. Although not necessarily a priority for the refuge, Stillwater NWR would under this alternative provide opportunities for studying other wildlife-related topics of broader application, such as the effects of removing livestock on salt desert shrub communities (Nevada Chapter-The Wildlife Society 1995).

In addition to wildlife-oriented research, the Service may also permit the use of the refuge for other investigatory scientific purposes when such use is compatible with the purposes, goals, and objectives of the refuge. Priority would be given to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats in their natural diversity (4 RM 6).

Monitoring Elements: Number of research projects conducted and participants for each.

Objective C.d.2: Facilities, equipment, and refuge lands would be maintained for potential use by researchers.

Basis of Objective: Providing facilities and equipment would facilitate research by non-Service institutions, in support of Subgoal C.d.

Strategies to Achieve Objective: Housing, equipment storage, and use of Service equipment would be provided at the discretion of the Refuge Manager, with priority given to research that furthers the goals and purposes of the refuge.

A research facility would be maintained at the location formerly owned by the Alves family, in the southeastern portion of the refuge along the Carson River. This facility could house researchers and equipment, and could serve as a base of operations.

There are many valuable habitat and wildlife-community assets on the refuge. The sand dune ecosystem at the northern end of the refuge holds particular promise, in that it would be designated as a research natural area under this alternative (Maps 3.6 and 3.7).

Monitoring Elements: Inventory of facilities available for researchers, occupancy of research quarters, listing of habitats used during research endeavors.

3.4.C.3 Anaho Island NWR

3.4.C.3.1 Management Program

Guiding Principles

Guiding principles for Anaho Island NWR would be the same as under Alternatives A and B, except that management efforts would be expanded to maintaining and restoring the island's natural biological diversity, to the extent that no conflicts with refuge purposes are created.

Goals, Objectives, and Strategies

Objectives for Anaho Island NWR would be the same as under Alternatives A and B, except the following goal and objectives would be added. This goal would be of secondary importance to the primary goal of the refuge (i.e., actions taken to accomplish Goal B would only be done to the extent that they do not conflict with Goal A).

Goal B: Restore and maintain natural biological diversity.

> **Objective B.1:** Restore and maintain a natural composition and structure of vegetation.
>
> **Objective B.2:** Provide research opportunities to provide information on the other species of birds, mammals, reptiles, invertebrates, and plants present on Anaho Island, and to provide better understanding of the effects of red brome, cheatgrass, and other invasive nonnative plants on native plant communities and possible ways to control these species.

Basis of Objectives: Little information is available on the other species that occupy Anaho Island. An invasion of nonnative plant species has been documented, but its potential effects on the island's native species is not well understood. Cheatgrass and red brome have the potential to significantly alter the vegetative structure on Anaho Island and they may increase the hazard of fire spreading into the colonial nesting areas, which could deleteriously impact colonial-nesting species if shrubs are eliminated. Additional information would help guide management of the island.

Strategies to Achieve Objectives: Research needs would be identified and pursued. Options would be explored for controlling cheatgrass and red brome.

Monitoring Elements: Final research reports submitted to the Service; acreage and distribution of plant communities and land cover, distribution and within-community composition of cheatgrass and red brome.

3.4.C.4 Other Program Areas

The management of other programs would be carried out as described under Alternative A, as modified in Alternative C, and as further noted below.

3.4.C.4.1 Partnerships and Other Cooperative Efforts

The guiding principles and strategies would be similar to those described under Alternative A, except that the following would be added. Members of the Fallon Paiute-Shoshone Tribe would be allowed periodic access to designated areas, for the purpose of conducting religious ceremonies or to teach their traditional ways. These areas would be delineated in a MOU, to be signed by the Tribe and the Service, and would be covered by a special use permit.

Under Alternative C, the Service would enter into an agreement with the U.S. Navy (Naval Air Station-Fallon) to the effect that the 3,000-foot ceiling over Stillwater NWR would remain along the existing northern boundary of the refuge and would not include the additional 26 sections that would be added between the existing boundary and the Bravo-20 Bombing Range under this alternative.

3.4.C.4.2 Fire Management

The guiding principles, goals, objectives, and strategies of the fire management program would be the same as outlined under Alternative A, except that "and farm" would be added to Objective 4, and an objective would be added to use prescribed fire as a management tool to simulate natural ecological processes.

3.4.B.4.3 Other Public Uses

Guiding Principles

Nonwildlife-dependent public uses would not be promoted or encouraged on Stillwater NWR, but may be permitted if they are found to be appropriate and compatible with refuge purposes and the Refuge System mission.

Strategies

Horseback riding would be permitted on open roads only and as outlined in a compatibility determination. A draft compatibility determinations is included in Appendix O. Other nonwildlife-dependent uses would not be permitted on the refuge until they are determined to be appropriate and compatible. A cooperative effort would be sought to provide camping opportunities during the nonhunting season through the Fallon Paiute-Shoshone Tribe, Bureau of Land Management, the City of Fallon, Churchill County, or private organizations with land near or adjacent to Stillwater NWR.

3.4.C.4.4 Cultural Resources Management

Guiding Principles

Under Alternative C, the goal of the cultural resource management program would be to manage cultural resources for the benefit of present and future generations. Almost all management activities that disturb the ground at Stillwater NWR and Fallon NWR invoke the National Historic Preservation Act (NHPA). However, cultural resource management would be more than simple compliance to the law. Several other laws, refuge needs, and Service policy compel a proactive approach to cultural resource management at Stillwater NWR and Fallon NWR. The Archaeological Resources Protection Act, the Native American Graves Protection and Repatriation Act, and Section 110 of the NHPA call for an active cultural resource program. Ways to increase our understanding of the Cattail Eaters culture would be explored with the Fallon Paiute-Shoshone Tribe and the Region's Cultural Resources Team. This would include funding sources. Stillwater NWR and the surrounding Lahontan Valley have a strong tradition of archaeological and ethnographic research, and this would be continued. The local Fallon Paiute-Shoshone Tribe has maintained a vital interest in its traditional culture and archaeology.

In addition to providing information about the local Tribe, environmental data contained in archaeological sites have contributed to our understanding of the natural ecological processes and biological diversity of the Stillwater area. This information was used in ascertaining natural ecological conditions prescribed in draft Goal 1 of Stillwater NWR.

Given the fragile and nonrenewable nature of archaeological resources, a cultural resource management program would include development and implementation of programs and activities for cultural resource education and interpretation on Stillwater NWR. Increased emphasis would be placed on interpreting cultural resource information to refuge visitors, including educating the public of the need to preserve cultural resources. Interpretation of cultural resources can be integrated with Goal 3 of Stillwater NWR, to provide opportunities for scientific research, environmental education, and wildlife-oriented recreation. By sharing knowledge of the Northern Paiute legacy at Stillwater Marsh, the Service would contribute to the development of partnerships in historic and wildlife conservation.

Reconnaissance surveys at Anaho Island NWR have failed to identify any significant prehistoric cultural resources (archaeological sites). However, Anaho Island figures prominently in the spiritual beliefs of the Pyramid Lake Paiute Tribe. Given the limited access to the island by visitors (it is closed to public access) and the largely passive management of the land and its wildlife, cultural resource management is not a significant issue at Anaho Island NWR.

Objectives and Strategies

The objectives for achieving the cultural resource management goal, which is to manage cultural resources for the educational, scientific, and cultural benefit of present and future Americans, are as follows.

Objective 1: Preserve archaeological resources for present and future cultural and scientific research.

Objective 2: Preserve cultural resources to contribute to the Service's trust responsibilities to the Fallon Paiute-Shoshone Tribe.

Objective 3: Conduct archaeological research to further goals of refuge management.

Objective 4: Implement programs and activities for cultural resource education and interpretation.

Objective 5: Provide opportunities for the Fallon Paiute-Shoshone Tribe to learn about and enhance their traditional cultural heritage in the Stillwater Marsh.

Strategies to achieve these objectives would include the following. The Service would take all necessary steps to comply with applicable laws and policies pertaining to the protection of cultural resources. Beyond compliance, the following strategies would be carried out to the extent that available funding and staffing would allow. It would require the addition of an archaeologist to the refuge staff, as proposed under this alternative. Refuge staff would assist Region One's Cultural Resources Team to locate and secure funding to implement the strategies that would require funding above base funds.

Several strategies would be carried out to achieve Objectives 1 and 2: to "Preserve archaeological resources for present and future cultural and scientific research," and to "Preserve cultural resources to contribute to the Service's trust responsibilities to the Fallon Paiute-Shoshone Tribe." A program would be established to monitor archaeological sites to record deterioration from erosion and vandalism, and to identify sites in need of special protection from erosion. Targeted archaeological sites susceptible to erosion could be stabilized with plantings or erosion cloth, as appropriate, and to the extent it is compatible with refuge goals. A plan would be prepared to protect and salvage data from archaeological sites in the event of serious flooding of cultural resources.

Cultural resource data would be incorporated into road planning and maintenance. For instance, existing roads that conflict with cultural resource preservation would be identified. Locations where barriers, guard rails or other devices could be installed to prevent off road vehicle traffic and to otherwise protect cultural resource sites would also be identified. This information would be used in deciding whether to close certain roads. Roads to be closed permanently would be targeted, as would roads to be closed or monitored in the event of flooding that expose considerable cultural resources. Sensitive archaeological areas and procedures for avoiding these areas during refuge projects, hunting programs, and other public-use activities would be identified. Cultural resource site locations and elevations would be incorporated into refuge Geographic Information System (GIS) database so that managers would have easy access to such data to determine the effects of refuge management activities on cultural resource protection, including water management.

A component of the program would be to identify, in various wetland units, water elevations above which archaeological sites could suffer erosion. This information could then be forwarded to water managers, so that they would have access this information when making water-management decisions. The information could also be used in deciding whether particular sites especially susceptible to erosion should be stabilized with plantings, erosion cloth, or other means. Before plantings or other erosion control measures are undertaken, compatibility with habitat objectives would be assessed.

An Adopt-A-Site program, to monitor selected archaeological sites, would be promoted and implemented given sufficient interest. Refuge law enforcement officers would be trained in the implementation of the Archaeological Resources Protection Act and cultural resource protection, and the Service would coordinate with law enforcement personnel in other agencies and Tribes to provide a law enforcement presence for cultural resource protection. Service law enforcement personnel would attend specific training in cultural resource protection, identification, the Archaeological Resources Protection Act, and Tribal consultations.

Several actions could be taken that would contribute to a better understanding of the northern Paiute culture and the natural ecological conditions of the area. As such, several objectives related to estimating natural hydrologic functioning and the natural composition of plant and animal communities could be achieved, in part, by carrying out the following strategies. For instance, environmental data contained in archaeological and geological sites could be recovered and interpreted to provide information on natural biological diversity and ecological processes of the Stillwater wetlands: (1) research results contained in existing reports, field notes and museum collections could be compiled and synthesized; (2) research questions could be identified that could potentially be answered by examining archaeological and other environmental deposits on the refuge, and these would be related to other goals and objectives of the comprehensive conservation plan; and (3) data could be recovered from archaeological and environmental deposits that contain environmental data identified in other investigations. Surveys for archaeological sites conducted on refuge should be done in the context of the predictive model (Zenah 1995).

Opportunities to accomplish cultural-resource research with third parties such as universities, volunteers, and museums would be developed. Results of archaeological research would be published in ways that are usable and accessible by scholars and the public. Research of other cultural resource questions identified in the "Wetland Element" of the *Nevada Historic Preservation Plan* would be encouraged.

Cultural resource education and interpretation would be coordinated with environmental education and interpretation on and off the refuge. For instance, other educational and interpretation programs on Stillwater NWR would be reviewed to assess whether cultural resources could be incorporated into them (e.g., boardwalks, interpretive signs, auto tour route). Classroom presentations on archaeology, prehistory, and conservation would be conducted in the Fallon school district and at Naval Air Station-Fallon. A program of guided tours of refuge habitats and traditional *Toedokado* use of the wetlands would be developed in concert with other guided tours. Opportunities to provide internships, volunteer opportunities, and modest stipends for researchers, volunteers, and special lab analyses for graduate students would be pursued. Assistance would be sought from local museums and other agencies and institutions in developing displays, exhibits, brochures, and interpretive activities. The refuge would actively participate in Nevada Archaeological Awareness Week.

All cultural resource research, interpretation, education, and preservation would be conducted in consultation with the Fallon Paiute-Shoshone Tribe (and Nevada State Historic Preservation

Office as appropriate). The refuge would facilitate opportunities for the Fallon Tribe to learn about and enhance their traditional cultural heritage. These opportunities would be pursued so they remain compatible with refuge purposes. Strategies would include encouraging the Fallon Tribe to identify traditional and sacred places on the refuge pursuant to the sacred Sites Executive Order #13009. The Service would facilitate, under special-use permits, visitation and ceremonial activities by the Fallon Tribe at these places, and would protect the sites from adverse effects. The Service would work with the Fallon Tribe to identify cultural items that need treatment according to the Native American Graves Protection and Repatriation Act.

The Service would also work with the Fallon Tribe to facilitate the harvest and use of traditional plant and animal resources. Such harvest and use would be for educational, ceremonial, artistic, and allied purposes necessary to learn about, or enhance, traditional culture. Harvest and use for subsistence and commercial purposes would not be allowed. For example, the Fallon Tribe in consultation with the Service would identify traditional plants and their gathering locations and establish a protocol for their protection, harvest, and use. The Service could also work with the Fallon Tribe to permit them to harvest other traditional resources, such as, rabbits and coots, for educational and ceremonial purposes.

3.4.C.4.5 Monitoring and Research Program

Guiding Principles

Guiding principles would be similar to those described under Alternative B, except more emphasis would be given to monitoring a wider range of species and plant communities.

Strategies

The monitoring program of Alternative A would be revised to more accurately reflect the objectives that would be adopted under this alternative. Adjustments would be needed due to the shift in management direction. Long-term data sets of the existing monitoring program would be evaluated to determine if they should be continued. It is anticipated that most, if not all, long-term data sets would be continued. Under this alternative, monitoring wetland-habitat acreage would be conducted quarterly (January, April, July, and October), corresponding to when the Nevada Division of Wildlife conducts their wetland surveys.

Given the focus on biological diversity, additional components would be added to the monitoring program (summarized in Appendix D). The monitoring program would encompass at least two main parts: monitoring of representative components of biological diversity and habitat parameters addressed in refuge objectives. Because of the many aspects of biological diversity, a hierarchical system would be adopted. Of most importance would be the monitoring of species richness in each major phylum, although this would not have to be done each year. Species observed would be compared to native species richness. Monitoring the relative abundance of representative species within each phylum would also be undertaken.

With respect to habitat management, quarterly monitoring of wetland-habitat acreage would be the most critical factor. Next in importance would be monitoring the relative mix (in acres) of habitat types within marsh, riparian, upland, and farmland areas. As part of this effort, the distribution of nonnative-dominated communities and riparian communities would be tracked. Within-community composition and structure would also be monitored, emphasizing marsh, riparian areas, and revegetated areas.

In addition to the core biological monitoring program, additional emphasis will be placed on monitoring the effects of all recreational activities and management techniques that involve commercial uses (for example, livestock grazing and muskrat trapping). In particular, a monitoring program would be designed to assess whether a sufficient amount of high-quality habitat is being provided in secure areas (free of human disturbance or of limited disturbances) for waterbird breeding, feeding, and resting.

Public use monitoring would include the components listed in Alternatives A and B, except that there would be an improved method for determining what percent of road use is done by refuge vehicles. Volunteers or staff members would monitor all vehicles entering and exiting the refuge on a monthly basis to assess a more accurate accounting of how many persons per vehicle should be assumed. This method would coincide with a national standard for assessing visitation. These numbers would be correlated with wildlife monitoring numbers to assess level of human disturbance. Appendix G describes the public use monitoring program of this alternative.

3.4.C.4.6 Budget and Administration

Several projects have been identified for implementation under Alternative C. The largest would be a refuge administrative complex which would include a visitor facility and maintenance shop, an estimated $4,687,200 under this alternative. Other projects include development of additional public use facilities such as auto tour routes, nature trails, observation areas and interpretive signs, an estimated $8,111,100 under Option 1 of this alternative and an estimated $3,602,700 under Option 2. Total capital costs of the water-rigths acquisition program are presented in the WRAP EIS (USFWS 1996a). Funding for these projects varies greatly depending on Congressional appropriations and the refuge's ability to obtain special project funds from sources such as grants, and Transportation Equity Act funds and, therefore, predicting the actual "nonsalary" funding is difficult.

The projected annual costs of managing the Stillwater NWR Complex under Alternative C would be an estimated $3.4 to $3.6 million/year (Option 1) or $3.3 to $3.4 million/year (Option 2) upon completion of the water-rights acquisition program. Projected annual expenditures include salaries; refuge operation and maintenance costs; water delivery and operation and maintenance charges; refuge revenue sharing payments; and water-rights leasing costs. Annual expenditures related to the water-rights acquisition program were discussed in Section 3.3.1.1, Features and Assumptions Common to all Alternatives. Refuge salaries and operations and maintenance costs would be an estimated $1.7 million/year under this alternative.

Refuge staff under Alternative C would be similar to Alternative A, except two additional positions would be added: a park ranger (GS-9 law enforcement) and an Archaeologist (GS-9/11), bringing the total number of permanent full-time positions to fifteen. An additional term position would also be added: a wildlife biologist (GS-7/9).

3.4.D ALTERNATIVE D

This alternative would stress restoring natural ecological processes to restore a natural diversity of wildlife and habitats. In particular, the natural hydrologic pattern would be replicated using water aquired through the Service's water-rights acquisition program. Other ecological processes would be permitted to operate unabated, and efforts would be made to allow natural restoration to occur. Large acreages of wetland-habitat would be provided during the spring and early summmber. Declining water levels during the late summer and fall would greatly benefit fall-migrating shorebirds. Monitoring of species of special interest, especially those identified as priority species in international bird conservation plans, would provide a check on management to determine whether the needs of these and other species are being adequately met.

The Alternative D boundary-revision would most significantly add an18-mile stretch of river-riparian habitat along the lower Carson River, a 21-mile long dune complex, and the lower portion of the Humboldt Slough where it enters the Carson Sink, thereby encompassing the junction of the Carson River and Humboldt River systems within the boundaries of the refuge. The contiguous portion of Fallon NWR, encompassing much of the Carson River delta, would be incorporated into Stillwater NWR, as would a vast area of salt desert shrub that is now in the Stillwater WMA.

Under this alternative, opportunities for nonconsumptive wildlife-dependent recreation would be enhanced considerably over existing conditions. The environmental education program would be enhanced and several areas for wildlife observation and environmental interpretation would be developed. Under this alternative, the Service would strive to balance opportunities for wildlife-dependent recreation. Waterfowl hunting would remain part of the program, but it would not receive as much emphasis as did in the past. Cultural resource management would become a proactive program under this alternative.

Anaho Island NWR would continue to be managed much as it has in the past, with an emphasis on protecting the nesting colony of American white pelicans and other colony-nesting birds that use the island. Monitoring would continue.

Some of the major headings under Alternative D are as follows:

Page
Broad Management Direction 3-174
Stillwater NWR
  Boundary 3-174
  Management Program
    Fish, Wildlife, and Vegetation Conservation 3-177
    Public Use Management 3-190
Anaho Island NWR 3-195
Other Program Areas 3-195

3.4.D.1 Broad Management Direction

3.4.D.1.1 Refuge Purposes

The purposes of Stillwater NWR and Anaho Island NWR would be the same as they would be under Alternatives B and C (noting that Fallon NWR would not exist under Alternative D). As with Alternative C, the original intent of establishing Fallon NWR would be carried on by adding the original purpose to the other purposes of Stillwater NWR for a Fallon Unit: i.e., to provide a sanctuary and breeding ground for migratory birds and other wildlife. Other provisions of Executive Order 5606 would also comprise management standards for the Fallon Unit.

3.4.D.1.2 Refuge and Program Goals

The goals of Stillwater NWR and Anaho Island NWR, and program goals would be the same as they would be under Alternative C. These goals are also repeated in appropriate sections that follow.

Other Program Areas

Several other programs would be maintained or enhanced under Alternative D. As yet, goals have not been established for these programs. The programs identified below are described in more detail later:

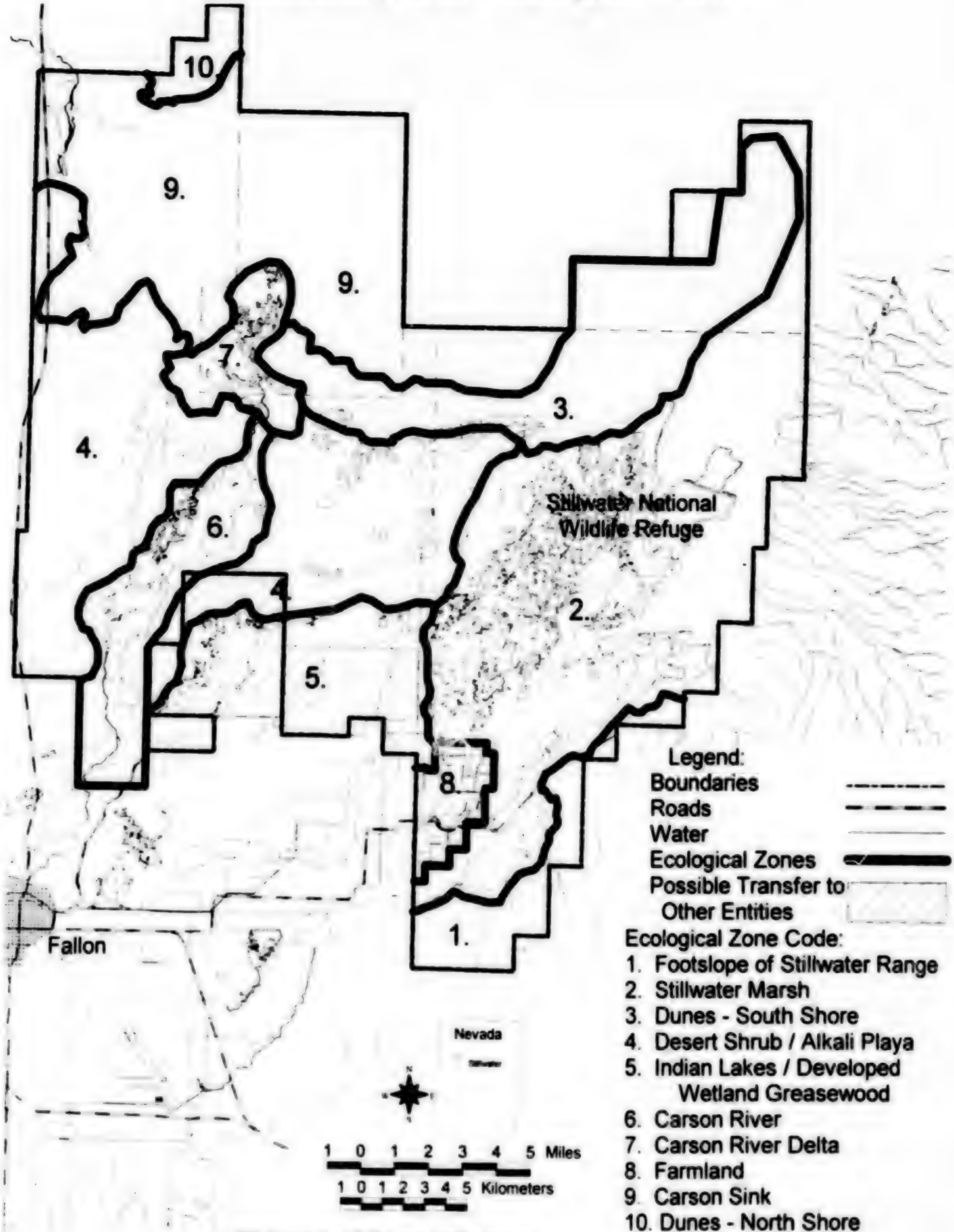
- Partnerships and Other Cooperative Efforts
- Water-Rights Acquisition and Land Disposal Program
- Fire Management
- Monitoring and Research Program
- Facilities Maintenance and Safety
- Law Enforcement
- Administration

3.4.D.2 Stillwater NWR

3.4.D.2.1 Boundary

Under this alternative, the boundary of Stillwater NWR would be revised to encompass all of Stillwater WMA and Fallon NWR, except the Indian Lakes area, and the six sections south of Stillwater WMA along the Carson River and the 26 sections north of Stillwater NWR that were identified in Alternative C (Map 3.8). This would provide opportunities for restoring and maintaining the natural biological diversity associated with the lower Carson River and its delta, the sand dune complex along the southern edge of the Carson Sink, and salt desert shrub uplands representative of the Carson Desert. This boundary configuration would also provide protection

Map 3.8 Stillwater Alternative D Boundary and Ecological Zones



GIS Analysis by U.S. Fish and Wildlife Service

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to the place where the Humboldt and Carson Rivers meet in the Carson Sink, considered a critical biogeographical contact point from the standpoint of biodiversity conservation (Charlet et al. 1998). All ecological zones that are now within Stillwater NWR, Stillwater WMA, and Fallon NWR would continue to be represented under this alternative (Map 3.8).

Upon completion of all required environmental analyses, boundary revisions could be pursued administratively under the Fish and Wildlife Act of 1956, as amended, or Congress could revise the boundary legislatively. Congressional approval would be required to dispose of any lands now within the Fallon NWR from the Refuge System.

As part of this alternative boundary revision, it would be proposed that the name and designation of Fallon NWR be rescinded, and that all of Fallon NWR be added to Stillwater NWR. The Bureau of Reclamation's primary withdrawal on these lands, as well as those in the Stillwater WMA, would have to be rescinded and replaced with a primary withdrawal by the Service.

It is possible that the Indian Lakes area will be transferred to Churchill County and subsequently to the City of Fallon, as authorized under subsection 206(g) of Public Law 101-618. The eight southernmost sections within this alternative's boundary revision, just north of the Fallon Paiute-Shoshone Indian Reservation is proposed for addition to the Stillwater NWR to the extent that it is not added to the reservation (Map 3.8). The Fallon Paiute-Shoshone Tribe has been exploring options for expanding the boundary of the reservation into this general area.

The existing 1987 memorandum of understanding with the U.S. Navy would be revised to reflect that the northward extension of the boundary toward the Bravo-20 Bombing Range would not result in the 3,000-foot ceiling being moved. The northern boundary of the 3,000-foot ceiling would remain at the northern limit of the existing, Public Law 101-618 boundary of Stillwater NWR. The designations of Stillwater WMA and Fallon NWR would no longer exist under this alternative.

3.4.D.2.2 Management Program

Goals, subgoals, and objectives of Stillwater NWR are long-term in nature; some could be achieved and maintained within a few years, whereas others may require several decades to accomplish. One driving force behind many of the wetland-related subgoals and objectives is the completion of the water-rights acquisition program, which, although it could possibly be completed within 15 years, could take 20 years or more to complete. Furthermore, restoration of the composition, structure, and functioning of riparian communities would take longer than 15 years. Goals and objectives are presented in the long-term because of the difficulty in estimating what can be accomplished within the 15-year planning horizon, and, more important, because,long-term, eventual goals and objectives are needed to adequately show the direction of management. Fifteen-year objectives must be developed within the context of long-term goals and objectives. Chapter 4 identifies the estimated progress that would take place toward meeting long-term goals and objectives. The CCP, when completed, will identify 15-year objectives, as well as long-term goals and objectives.

This section is divided into two main parts: (1) Native Fish, Wildlife, and Vegetation Conservation; and (2) Public Use Management. For each of these parts, guiding principles, the refuge goals (identified earlier), subgoals, objectives, and strategies are outlined. The outline for Alternative C (page 117) applies to this alternative as well, except where noted below.

3.4.D.2.2.1 Native Fish, Wildlife, and Vegetation Conservation

Guiding Principles

The guiding principles under this alternative are similar to those of Alternative C, except for the differences noted below. A strict interpretation of biodiversity conservation principles would be undertaken as part of this alternative. Figure 3.1 illustrates one of the ways in which the objectives of this alternative differ from the objectives developed for other alternatives.

This alternative would assume that, by mimicking natural hydrologic patterns and other natural processes, the best possible approximation of natural biological diversity would result. With respect to hydrology, this alternative would focus on approximating natural *patterns* of water flow into and through the marshes as opposed to the *conditions* these flow patterns produced under natural conditions. One exception to this is that Alternative D would give greater emphasis to natural geomorphology and topography than would Alternative C. No adjustments would be made to the natural hydrologic patterns to reduce nest flooding (resulting from mimicking hydrologic patterns with a significantly reduced water supply) or to provide additional habitat during the fall and winter for waterfowl and waterfowl hunting. These are the major differences as compared to Alternative C.

Objectives and Strategies

The goals, subgoals, objectives, and their rationale under Alternative D would be the same as they would be under Alternative C, except the following additions and replacements. The numbering system was kept the same to help in comparisons with Alternative C. The following goals and subgoals are the same as Alternative C, and many of the objectives are the same. Several objectives were modified or deleted. Strategies that would be undertaken under Alternative D are described, except where they would be the same as under Alternative C.

Goal A: Conserve and manage fish, wildlife, and their habitat to restore and maintain natural biological diversity.

Subgoal A.a. Approximate natural diversity within and among animal communities on Stillwater NWR.

As under Alternative C, this subgoal and accompanying objectives would be achieved primarily through strategies outlined under Subgoals A.b and A.c. In other words, wildlife would be managed in large part through managing their habitat. The boundary-revision proposed under this alternative would also contribute to the accomplishment of this subgoal and objectives. Migratory waterbirds and neotropical migratory birds are important components of the area's natural biological diversity. Several population and use-level objectives have been identified for some birds and groups of birds at the flyway, regional, state, and local levels in international bird conservation plans, including the Intermountain West Joint Venture Implementation Plan (Intermountain West Joint Venture 1995) and Nevada Partners in Flight Bird Conservation Plan (Partners in Flight 1999). Although population or use-level objectives would not be established for Stillwater NWR under Alternative D, objectives and strategies under Goal A would generally support the population targets identified in the bird conservation plans.

Except for a revised Objective A.a.2, the objectives would be the same as the corresponding objectives outlined under Alternative C. The strategies differ to some degree.

Objective A.a.1: Restore and perpetuate the presence of all native species and native guilds of birds, mammals, reptiles, amphibians, fish, and invertebrates, according to season (Appendix B).

Objective A.a.2: Restore and perpetuate population levels (or, use level of the refuge) by each species to relative-abundances (e.g., rare, uncommon, common, abundant) that would exist under natural conditions, recognizing natural fluctuations in populations.

Basis of Objectives: same as Alternative C.

Strategies to Achieve Objectives: Strategies would be the same as under Alternative C, except that predator control would not be undertaken except when a species is shown to be at risk and (1) the species impacting the population of another species is significantly more abundant on the refuge than would occur naturally; (2) predation or nest depredation is shown to be a major cause of the species' limited population; and (3) other measures are not timely or feasible. Pesticides would not be used to control carp.

Monitoring Elements: same as Alternative C.

Objective A.a.3: Minimize distribution and abundance of nonnative animal species and their prominence in fish and wildlife communities, in the near term focusing on:

Basis of Objectives: Same as Alternative C.

Strategies to Achieve Objectives: Carp and other nonnative fish species would be controlled primarily through water management (e.g., drying of wetland units), but other passive methods would be explored.

In carrying out nonnative fish control measures, it would be recognized that white pelicans and other species make heavy use of carp and other nonnative fish as a food source. Therefore, control efforts would not be initiated marsh-wide in any given year.

Monitoring Elements: Distribution and relative indication of density or abundance of carp, other nonnative fish, and bullfrogs.

Subgoal A.b: Approximate, within a natural range of variability, a natural diversity within and among plant communities, habitats, and ecological functioning.

Objective A.b.1: Restore and perpetuate the presence of all native plant species (Appendix B) and native plant communities in Stillwater Marsh, Carson River corridor and its delta, Stillwater Slough corridor, dune complex, and salt-desert shrub uplands.

Objective A.b.2: Approximate and perpetuate the mix of plant communities and habitat types that would occur on Stillwater NWR under natural conditions — within a natural range of variability — including representation by all native plant communities and habitat types, amount of area occupied by each plant community and habitat type, and the distribution and pattern (shape) of each.

Objective A.b.2(a): Attain and sustain a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR, including marsh (palustrine), shallow lake (lacustrine), and riverine wetland-habitat as described in more detail below.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objectives: Same as Alterantive C.

Monitoring Elements: Same as Alternative C.

Stillwater Marsh (A.b.2(b)):

Objective A.b.2(b)(i): Attain and sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh. (Reference to seasonal acreages in Alternative C was removed for this alternative because the emphasis would be on mimicking the natural seasonal pattern of inflow (Objective A.b.2(b)(iv)) and wetland-habitat acreage would viewed as a result of the natural seasonal flow pattern, rather than an objective for it.) Objective A.b.2(a) identifies the targeted 14,000 acres for the entire refuge.

Basis of Objectives: Public Law 101-618 (Subsection 206(a)) requires that 25,000 acres of primary wetland-habitat be maintained in the Lahontan Valley. Of this target, 14,000 acres will be maintained on Stillwater NWR(USFWS 1996a, b), and of this, a long-term average of 13,500 acres would be maintained in Stillwater Marsh.

Strategies to Achieve Objectives: Water rights and water would continue to be secured as outlined in the 1996 WRAP EIS/ROD until it is determined that a long-term average of 13,500 acres of wetland-habitat is being maintained in Stillwater Marsh on Stillwater NWR. Acquiring water rights for Stillwater NWR wetlands also supports directives in the Refuge System Administration Act, as amended, to acquire water rights needed for refuge purposes, and strategies identified in the Nevada Partners in Flight Plan and the U.S. Shorebird Conservation Plan, Intermountain West Region.

An alternative to the objective of attaining and sustaining a long-term average of 13,500 acres of wetland-habitat would be to more closely approximate the natural composition, structure, and functioning of Stillwater Marsh using the volume of water identified in the 1996 EIS/ROD, *Water Rights Acquisition for Lahontan Valley Wetlands*. Under this approach, the Service could more closely approximate natural biological diversity, but it would be done on a smaller scale (less than a long-term average of 4,000 acres of wetland-habitat). Major modifications to water delivery and control facilities would be required, and, more important, this approach would be inconsistent with subsection 206(a) of Public Law 101-618.

Monitoring Elements: At present, the record of decision for the WRAP EIS specifies that wetland-habitat acreage will be monitored annually in August. Alternatives to this are being evaluated in this Draft EIS (Section 4.3.3.1). During the surveys, wetland-habitat acreage will be determined by the total acreage of the wetted area within wetlands.

Objective A.b.2(b)(ii): This objective of Alternative C would not be included in Alternative D.

Objective A.b.2(b)(iii): Within five years, examine the feasibility and, if appropriate, develop a plan to restore native wet-meadow habitat on the properties formerly owned by the Kents and Weishaupts.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objectives: Same as Alterantive C.

Monitoring Elements: Same as Alternative C.

Objective A.b.2(b)(iv): Approximate a natural seasonal flow-volume pattern, including natural variability among years, by delivering water to Stillwater NWR in the following seasonal proportions of the annual volume of deliverable water (in addition to drainwater flowing into the refuge), ensuring that peak inflow occurs during May.

	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
Low water-year	0-15%	70-100%	0-10%	0-10%
Full water-year	5-15%	70-90%	5-10%	0-10%
Spill year	10-30%	60-90%	5-10%	0-5%

Objective A.b.2(b)(v): Restore, approximate, design, and maintain physical features of the marsh (e.g., geomorphology, topography, water-control facilities) in a way that facilitates natural hydrologic patterns, including one, or more, deeper channels running the length of the marsh (e.g., simulating Stillwater Slough of the Government Land Office maps of the late 1800s and other historic maps).

Objective A.b.2(b)(vi): During peak inflows, attain flow rates of 500-1,000 cfs from one end of the marsh to the other through one primary route (e.g., simulated Stillwater Slough).

Basis of Objectives: These objective and strategies support Objectives A.b.1-A.b.2(a). Mimicking the seasonal pattern of wetland-acreage is key to approximating the natural diversity of plants and animals occupying the marsh. Peak acreage under natural conditions typically occurred between April and June, and the low point was generally in August/September.

Objective A.b.2(b)(iv) assumes that mimicking the natural seasonal flow pattern will in large part produce natural habitat conditions and associated wildlife diversity.

By tailoring management to achieve the above stated objective, important hydrologic functions would be simulated, such as declining water levels from July through October, rising water levels during the early spring, and to some extent higher springtime flow rates into and through wetland units.

At a regional and flyway level of restoring natural biological diversity, the objective also contributes toward wetland-habitat goals and objectives of the Intermountain West Joint Venture, Nevada Partners in Flight, and U.S. Shorebird Conservation Plan Intermountain West Region, especially those dealing with breeding and migration habitat.

Strategies to Achieve Objectives: Strategies would be the same as Alternative C, except for the following: (1) more emphasis would be given to natural geomorphology and topography; (2) efforts would not be taken to ensure that brood habitat remains beyond any point in time (reliance would be on brood survival under natural lowering of wetland units through evapotranspiration); (3) a pool of water would not be held back to control botulism or to sustain wetland-habitat into the fall and winter beyond that provided under more natural conditions; and (4) water control structures and other modifications would be made to accommodate up to 1,000 cfs from the upper end of the marsh to the lower end, and the Service would work with the appropriate parties to increase the capacity of canals leading to the refuge to accommodate deliveries of up to 1,000 cfs (as compared to 800 cfs under Alternative C).

Under Alternative D, more effort would be taken to simulate natural flow rates and water depths. For instance, a meandering channel and other modifications to the topography of wetland units would be undertaken, in addition to modifications to water control structures, along a series of wetland units to simulate the effects of Stillwater Slough running the length of Stillwater Marsh under natural conditions (e.g., enhanced water distribution along the length of the marsh). Consideration would be given to doing this along the following route: Tule Lake (assuming a canal connecting it with the West Canal) to (Swan Check) to Pintail Bay to Carson Sink. This would require major modifications.

Water levels would be rise beginning in late winter or early spring and continue through into May.

Water levels throughout most of the marsh would begin declining starting in June. Declining water levels would proceed through December, January, or February in many wetland units. The strategy of allowing water levels to decline during the late summer and fall would benefit fall-migrating shorebirds by concentrating and exposing invertebrates as water levels decline.

In the other wetland units, declining water levels would be curtailed in September or October due to reductions in evapotranspiration and increased inflows. From October through early spring, water levels in most units would rise or would remain constant, and few would experience declining water levels during this period.

Monitoring Elements: Water receipts, wetland inflows by source (e.g., drainwater, deliveries, spill-water, groundwater) by month.

Carson River and Stillwater Slough

Objective A.b.2(c)(i): Attain and sustain a long-term average of 50 to 100 acres of riverine-wetland-habitat on Stillwater NWR.

Objective A.b.2(c)(ii): Restore cottonwood, mesic shrub (e.g., willow, rose, buffalo-berry), wet meadow, riverine-aquatic communities to their natural distribution and extent along the lower Carson River and Stillwater Slough.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objectives: Same as Alterantive C.

Monitoring Elements: Same as Alternative C.

Objective A.b.2(c)(iii): Restore or approximate the natural geomorphology of the Carson River and side-channels, and Stillwater Slough to facilitate the approximation of natural hydrologic patterns.

Basis of Objectives: The geomorphology of riverine systems, in combination with hydrology, determine the riverine and riparian habitats that can be produced.

Strategies to Achieve Objectives: The difference between this objective and those under Alternative C is that the above objective focuses on the restoration of geomorphology features as an objective, rather than as a strategy to achieve river and riparian habitat objectives. Strategies for restoring the natural geomorphology and hydrologic functioning of the Carson River and side channels, and of the Stillwater Slough would be developed as a step-down management plan. A more detailed assessment would be made of the natural conditions of relevant features, including further examination of archaeological field notes and ethnographies. A more thorough assessment would be made of the native plant species occurring in the Stillwater area, including a review of existing archaeological reports, field notes, and museum collections, and possibly through additional examination of archaeological deposits. Objective levels of each attribute would be based on estimated natural conditions and the anticipated maximum, minimum, and frequency of surface water flows.

Monitoring Elements: Seasonal acreage of wetland-habitat, distribution and acreage of each riparian vegetation type, and riverine geomorphological features.

Carson River delta (A.b.1(d)):

Objective A.b.2(d)(i): Attain and sustain a long-term minimum average of 400 acres of wetland-habitat in the Carson River delta.

Objective A.b.2(d)(ii): During years when water reaches the Carson River delta via the Carson River (spill-years), approximate natural habitat conditions *(see objectives under Subgoal A.d., Monitoring and Management Studies).*

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objectives: Same as Alterantive C.

Monitoring Elements: Same as Alternative C.

Upland Areas (A.b.1(e)):

Objective A.b.2(e)(i): Restore, approximate, and maintain the natural distribution and abundance of upland plant communities and habitat types that would exist naturally, according to location, throughout upland portions of the refuge (same as Alternative C).

Basis of Objectives: Upland communities are a major component of the Lahontan Valley's biological diversity. Approximating natural vegetation characteristics is key in restoring these communities. The plant communities have been impacted by the introduction of nonnative invasive species and livestock grazing, which in turn has impacted native fauna associated with these habitats.

Strategies to Achieve Objectives: Removing livestock grazing from upland areas on the refuge would be the main strategy for restoring these habitats. Thus, upland areas would be permitted to recover more-or-less on their own.

However, limited efforts may be employed to control nonnative vegetation in localized areas. The approach would be similar to Alternative C, except that herbicides and prescribed burning would not be used under this alternative, and only limited use of mechanical treatments would be used. Native insects, currently found in the area, would continue to provide biological control. Native insects would not be manipulated or moved under this alternative, nor would nonnative insects be introduced for biological control.

All previously farmed areas acquired by the Service within the refuge would be revegetated to native plant communities and no farmland or other agricultural fields would be maintained.

Monitoring Elements: Distribution and acreage of upland habitats types and plant communities.

Objective A.b.3: Approximate, within each habitat type and plant community, a natural species composition; emphasizing the domination of these communities by one or more native species representative of the community (Table 2.2) and reduce, or eliminate, if possible, the number of nonnative species. (Same as Alternative C.)

Objective A.b.3(a): For each habitat type and plant community, determine the approximate proportion that each of the major plant species should comprise within the community, and develop targets based on this assessment.

Objective A.b.3(b): Prevent the establishment of any nonnative species not already present within the boundaries of Stillwater NWR, especially species listed as a noxious weed (e.g., purple loosestrife, Eurasian water milfoil).

Objective A.b.3(c): Curtail the spread of noxious weeds and other nonnative invasive vegetation within Stillwater NWR, and reduce the amount of area dominated by saltcedar and perennial pepperweed, including reducing the composition in plant communities.

Basis of Objectives: same as Alternative C.

Strategies to Achieve Objectives: Strategies to achieve these objectives would be similar to those outlined for Alternative C, except that: (1) cattle grazing would be eliminated from the refuge and would not be used as a management tool, even for integrated weed management; (2) herbicides would not be used under any circumstances and mechanical treatments would be minimized; (3) fire would not be used except to simulate natural fire.

Monitoring Elements: same as Alternative C.

Objective A.b.4: Approximate, within each habitat type and plant community, the vegetative structure of plant communities that would occur under natural operation of ecological processes, such as spring flooding, drought, succession and competition, accumulation of residual plant material, herbivory, seed caching, long intervals between fires, including:

Stillwater Marsh and Carson River delta (A.b.4(a)):

(i) A natural pattern of emergent vegetation and open-water areas in the marsh that is maintained by deeper channels and by disturbances such as spring flooding and muskrat grazing, or secondarily, a mosaic that simulates natural disturbances; and

(ii) Portions of the marsh having residual vegetation that has accumulated for five years or more.

Basis of Objective: Same as Alternative C.
Strategies to Achieve Objectives: The strategies to achieve these objectives would be similar to those of Alterantive C, except that muskrat trapping would not be used to control grazing of marsh vegetation, and livestock grazing and prescribed burning would not be used.
Monitoring Elements: Same as Alternative C.

Lower Carson River and Stillwater Slough (A.b.4(b)):

(i) An overstory of cottonwoods and/or willows along most stretches;
(ii) An understory of native grasses and grass-like plants, forbs, and young cottonwoods and mesic shrubs (e.g., willows, rose, buffaloberry); and
(iii) Some areas dominated by grasses and grass-like plants (i.e., no woody overstory);
(iv) Carry-over of native herbaceous plant material (residual vegetation) from season-to-season and year-to-year during most periods, recognizing that spring flooding would naturally have matted some vegetation and induced decomposition, and that fires (late summer or fall) would have been infrequent.

Basis of Objective: Same as Alternative C.
Strategies to Achieve Objectives: Strategies would be similar to Alternative C, except that prescribed grazing and burning would not be used.
Monitoring Elements: Same as Alternative C.

Uplands (A.b.4(c)):

(i) An overstory of native shrubs in many communities, with some communities having an extensive understory of Indian ricegrass and other native bunchgrasses;
(ii) Extensive amounts of bare soil between shrubs in many communities;
(iii) A build-up of residual plant material from native bunchgrasses and forbs, allowed to accumulate naturally over the years (i.e., not grazed or trampled by livestock, crushed by off-road vehicles, etc.).

Basis of Objectives: Same as Alternative C.
Strategies to Achieve Objectives: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

Objective A.b.5: Approximate water conditions that would occur naturally, according to location of wetland-habitat (i.e., fresh in riverine and the upper end of marsh, and brackish at the lower end of marsh), in a way that contributes toward the approximation and maintenance of the natural extent, distribution, composition, and structure of plant and animal communities.

Objective A.b.5(a): Maintain the lowest possible total dissolved solids levels in all upper Stillwater Marsh (generally <600 mg/L during February-June and <1,000 mg/L during the remainder of the year) and portions of the mid and lower Stillwater marsh that are within the flow route of water through the wetland units (<5,000 mg/L); and simulate other key hydrologic factors of the natural marsh such as large volumes of water flowing through the marsh. Wetlands lower down in the system and and off-channel areas would at times have much higher levels of total dissolved solids, possibly approaching 100,000 mg/L in some locations.

Objective A.b.5(b): Manage wetlands water on Stillwater NWR to maintain concentrations of potentially toxic trace elements below effect levels, identified below, while recognizing that maintaining concentrations below these levels in the refuge's wetlands may not be attainable in all wetland units (e.g., wetlands lower on the hydrologic gradient) at all times of year (e.g., later in the summer when wetland-habitat acreage shrinks), or during all time periods (e.g., regional drought conditions). (See list under Objective A.b.5(b) of Alternative C.)

Objective A.b.5(c): Minimize the amount of mercury entering Stillwater NWR wetlands and reduce mercury levels in wetland sediments and biological tissues to non-hazardous levels.

Basis of Objectives: Same as Alternative C.
Strategies to Achieve Objectives: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

Subgoal A.c: Allow and provide for natural types, levels, rates, and distributions of biotic processes, such as herbivory, granivory, predation, population fluctuations of resident wildlife, and production; minimize or exclude processes not natural to the area or that are above or outside the levels, rates, locations, or communities that would occur naturally. Exceptions to this include: (1) diseases such as botulism and cholera, which would be minimized; and (2) browsing by deer and other wildlife may be controlled, to allow the reestablishment of native vegetation. (Same as Alternative C.)

Objectives A.c.1-2 and strategies — Same as Alternative C.

Objective A.c.3 would not be included under Alternative D, as direct control of wildlife populations would not be component of this alternative.

Subgoal A.c: Allow and provide for natural types, levels, rates, and distributions of biotic processes, such as herbivory, granivory, predation, population fluctuations of resident wildlife, and production; minimize or exclude processes not natural to the area or that are above or outside the levels, rates, locations, or communities that would occur naturally. (Similar to Alternative C.)

Objective A.c.1: Prevent grazing and browsing by nonnative herbivores above natural levels (use and distribution) for any given plant species and community, and season for these species and communities, and prevent fires in upland areas.

Basis of Objectives: Same as Alterantive C.

Strategies to Achieve Objectives: Same as Alterantive C.

Monitoring Elements: Same as Alterantive C.

Objective A.c.2: Allow native herbivores to graze and browse at natural levels (use and distribution).

Basis of Objectives: Same as Alterantive C.

Strategies to Achieve Objectives: Same as Alterantive C, except that fewer exceptions would be made for muskrat trapping. Muskrat trapping would only be permitted within 100 feet of dikes, water control structures, and other facilities that could be damaged by musktrats.

Monitoring Elements: Same as Alterantive C.

Objective A.c.3: Prevent excessive depredation of nests or wildlife species when depredation of nests or predation of young or adults poses a threat to the population.

Basis of Objectives: Although predator control would be deemphasized in this alternative, there are emergency situations where it may be needed.

Strategies to Achieve Objectives: Predator control measures would not be implemented unless production of a species of special concern was significantly impaired by predation or nest depredation. In these cases, a targeted program to resolve the immediate threat would be designed and implemented with the appropriate level of NEPA documentation. The least invasive technique available would be used in all such control efforts.

Monitoring Elements: Monitoring would only be undertaken in conjunction with a predator control program.

Objective A.c.4: Prevent human disturbances that would materially affect the use of the refuge by native wildlife, nest success of waterbirds and riparian birds, overall production, daily activity patterns of birds, use of important feeding habitats by waterbirds during migration and winter and the nutritional status of these birds, and other biotic processes.

Objective A.c.4(a): Maintain a minimum of 4,000 acres of sanctuary in a way that ensures that the full range of life-history requirements of all major waterbird guilds are contained in the selected areas.

Objective A.c.4(b): Minimize public use impacts to wildlife in areas outside the sanctuary while still providing opportunities for compatible wildlife-dependent recreation.

Basis of Objectives: Same as Alterantive C.

Strategies to Achieve the Objective: Same as Alternative C, except the following differences during the hunting season.

During the hunting season, water flowing into Stillwater Marsh would be apportioned in the following way:

- the first 4,000 acres[A] of wetland-habitat would be maintained in the sanctuary; and
- each additional 3,500 acres would be distributed as follows, in this order:
  - general public use area (1,000 acres),
  - hunt area (2,000 acres), and
  - sanctuary (500 acres).

The following units would be maintained as year-round sanctuary: Stillwater Point Reservoir (except immediately adjacent to the wildlife viewing site and boardwalk), Upper and Lower Foxtail Lakes, Doghead Lake, Dry Lake, Cattail Lake, Division Pond, and East Alkali Lake (Map 3.9; public use management section). No public access would be permitted in these units year-round. The amount of wetland-habitat available for flooding in the sanctuary would be about 5,000 acres under this alternative. Areas open for wildlife viewing would provide additional areas that would provide at least some level of security for hunted species of birds. When they have water during the fall and winter, the Carson River corridor and its delta wetlands in the area now encompassed by Fallon NWR would provide additional wetland-habitat in a nonhunt area.

Motorized boats (except those powered by electric motors) would not be permitted on the refuge, although nonmotorized boats and boats with electric motors would be permitted in wetland units open to hunting during the hunting season, and two units in the general public use area would be open to limited nonmotorized boat use. All lands and waters that are currently within the Stillwater WMA and Fallon NWR would be closed to hunting.

As compared to Alternative C, the West and East Pasture units would not be flooded to mitigate the effects of hunting elsewhere on the refuge.

[A] To mitigate possible adverse impacts to waterfowl hunting opportunities in the near term (due to the restrictions identified above), the minimum sanctuary size would be phased in over a period of six years. For the first three years, the minimum sanctuary size would be 2,500 acres of wetland-habitat, followed by another three years in which the minimum sanctuary size would be 3,500 acres. After six years, the minimum sanctuary size would be increased to 4,000 acres.

Monitoring Elements: Same as Alternative C.

Goal B: Contribute toward the fulfillment of obligations of international treaties and other international agreements with respect to fish and wildlife.

Under Alternative D, it would be assumed that this goal would be accomplished to the extent that Goal A is achieved; i.e., no additional objectives would be needed to accomplish this goal.

3.4.D.2.2.2 Public Use Management

Guiding Principles

Guiding principles would be the same under this alternative as under Alternative C, except uses other than the six priority uses would not be allowed, such as camping, bicycling, off road vehicle use, and horseback riding.

Objectives and Strategies

All of the subgoals, objectives, and their basis for Alternative D would be the same as Alternative C. The subgoals and objectives are repeated for clarification purposes, but the basis for each of the subgoals and objectives and the monitoring elements are not repeated.

Goal C: Provide opportunities for environmental education and wildlife-dependent recreation that are compatible with refuge purposes and the Refuge System mission.

Subgoal C.a: Provide opportunities for high-quality hunting experiences.

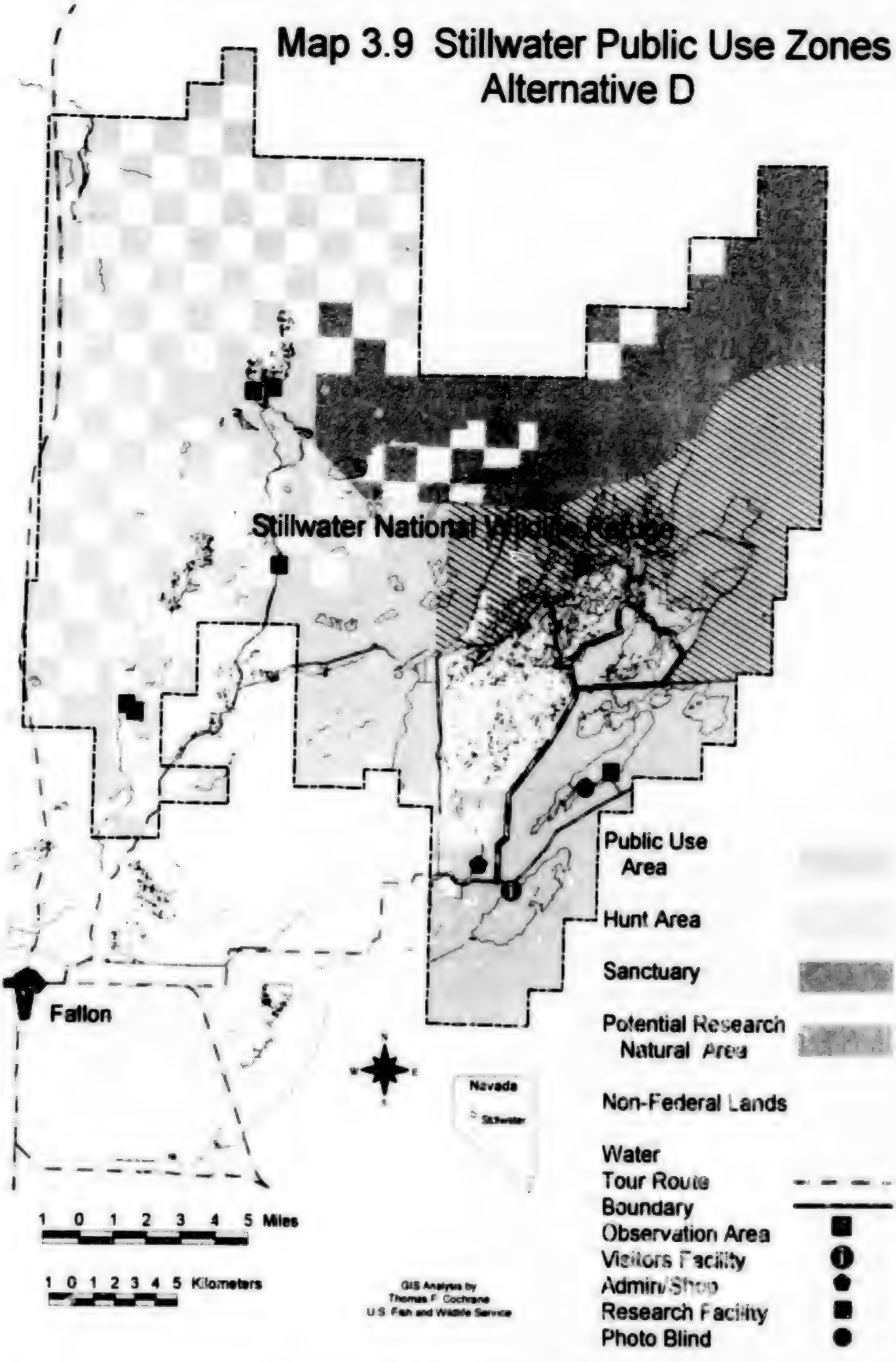
Objective C.a.1: Provide opportunities in which hunters would have a reasonable chance of success in uncrowded conditions and would meet the needs of a broad spectrum of users.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objective: Under Alternative D, hunting would be permitted in Stillwater Marsh only, and would be limited to waterfowl hunting and California quail. The hunt program would be maintained in the following areas: West Marsh, Swan Lake, Pintail Bay, North Nutgrass Lake, and Big Water (Map 3.9). At the completion of the water-rights acquisition program, it is anticipated that up to about 1,000 acres of the fall and winter wetland-habitat in Stillwater Marsh would be consistently open to waterfowl hunting during nonspill years under this alternative. In spill years (one of four years) and years following a spill year, it would be as high as 6,500 acres.

Hunter densities would be monitored in part to maintain relatively low-density hunting opportunities now available on Stillwater NWR. "Uncrowded conditions" would be further defined.

Map 3.9 Stillwater Public Use Zones
Alternative D



GIS Analyses by
Thomas F. Cochrane
U.S. Fish and Wildlife Service

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Nonmotorized water craft or those powered by electric motors would be allowed in open areas. Opportunities for camping and overnight stays would not be provided on refuge lands. As in Alternatives B and C, a cooperative effort would be sought to provide camping opportunities near the wetlands.

Under this alternative, hunting opportunities for California quail would be allowed during the appropriate season in the hunt area of Stillwater Marsh. Lead shot would not be permitted.

Monitoring Elements: Number of hunters, demographics, feedback on the quality of hunting experience.

Objective C.a.2: Ensure that hunting experiences are safe.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objectives: Same as Alternative C.

Monitoring Elements: Same as Alternative C.

Subgoal C.b: Provide opportunities for environmental education and interpretation that meet requirements of a broad spectrum of users.

Objective C.b.1:.Provide adequate facilities, equipment, and staffing for environmental study and interpretation, including facilities within the nonhunt public-use area of the refuge.

Basis of Objective: Same as Alternative C.

Strategies to Achieve Objective: An accessible two story facility to support environmental education and orient visitors would be constructed at Stillwater Point Reservoir. The second story would provide optimum viewing of the marsh habitat located on and around the Stillwater Point Reservoir. The first story would contain an audio/visual auditorium, two classrooms, interpretive exhibits and storage area. The facility would be staffed with volunteers seven days a week.

Volunteers would be trained to answer questions relative to Stillwater NWR and provide background and local information to satisfy the curiosity and broaden the awareness of a wide range of visitors. This knowledge would include familiarity with the refuge infrastructure as well as resident and migratory wildlife in the area. Staff would also have cultural resource training.

Boardwalks would be designed and constructed at the north end of Stillwater Point Reservoir to allow access into the marsh. A portion of the boardwalk would be shaded to accommodate outdoor study. Parking areas would be improved to accommodate a number of busses and private vehicles simultaneously. The road to this complex would be improved to provide all-weather accessibility.

The property formerly owned by the Alves family would be developed to provide an increased opportunity for scientific research and on-site learning. Existing structures would be evaluated for utility and unnecessary structures removed. A kiosk would be designed and constructed at the Alves property to serve as a trailhead to the riparian area along the Carson River. An accessible trail would be designed with an accompanying leaflet depicting trail route and location and resident and migrating bird species. A site north of the Stillwater Marsh would be equipped with an accessible boardwalk and viewing tower to overlook the unique system of dunes and the Carson Sink. Interpretive panels would be developed to help visitors gain an understanding of the natural biological diversity of the refuge and the geologic functions that shaped the natural resources. The kiosk would also provide an explanation of some of the area's cultural history. Similar facilities would be developed at Battleground Point. At the property formerly owned by the Weishaupt family, office and maintenance facilities would be constructed. The existing homestead would be retrofitted to accommodate offices, while a new maintenance facility would be developed to the south of the office building capable of housing refuge maintenance vehicles and boats and providing sufficient work area. The off-site environmental education program would be similar to that described in Alternatives B and C.
Monitoring Elements: Same as Alternative C.

Objective C.b.2: Provide for the needs of students and teachers and make refuge and Service programs available to them.

Basis of Objectives: Same as Alternative C.
Strategies to Achieve Objectives: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

Objective C.b.3: Provide adequate interpretation of natural and cultural aspects of the area to satisfy the curiosity, and broaden the awareness, of a wide spectrum of visitors.

Basis of Objective: Same as Alternative C.
Strategies to Achieve Objective: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

Subgoal C.c.: Provide high-quality opportunities for wildlife viewing and photography.

Objective C.c.1: Provide high-quality viewing opportunities throughout the distinctive habitats of the refuge.

Basis of Objective: Same as Alternative C.
Strategies to Achieve Objective: An all-weather auto tour route would be developed from the visitor facility to the interior of Stillwater Marsh. The tour route would be the same as under Alternative B, except that it would also extend around Tule Lake (Map 3.9). Furthermore, other roads throughout the refuge would be improved so the public could easily access the entire refuge, from the visitor facility to the dunes, to Timber Lakes and Battleground Point. The interpretation of the tour route would be accomplished by directional signs with occasional information kiosks that point out and describe natural features and wildlife. Two nature trails would be developed along the tour route. The need to close roads during the nesting season would be periodically assessed. Nature trails would also be developed along the Carson River and in upland habitats. Wildlife viewing trails would be developed at Timber Lakes as in Alternative C. A cooperative effort would be sought with entities such as those mentioned in the Hunting section of Alternative B to provide camping opportunities near Stillwater NWR.
Monitoring Elements: Same as Alternative C.

Objective C.c.2: Provide opportunities for high-quality experiences in wildlife photography.

Basis of Objectives: Providing facilities for viewing wildlife (e.g., roads, pullouts, observation sites) is important for providing high-quality viewing opportunities. Achievement of this objective would provide the public with the opportunity to view wildlife and the relationships between resource management, wildlife and habitat, and people.
Strategies to Achieve Objectives: In addition to strategies under Objective C.c.2, a photography blind would be designed and constructed near the Lower Foxtail Lake unit to facilitate photographing waterfowl and the great blue heron rookery. To ensure impacts to wildlife are kept to a minimum, access would be allowed by reservation only.
Monitoring Elements: Same as Alterantive C.

Subgoal C.d: Encourage and provide opportunities for research by other agencies (e.g., USGS, Agricultural Research Service), universities, and other institutions, especially as they relate to the management goals and objectives of Stillwater NWR.

Objective C.d.1: Foster relationships with government agencies, conservation groups, and institutions of higher education and communicate the most critical research needs of the refuge.

Basis of Objectives: Same as Alternative C.
Strategies to Achieve Objectives: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

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Objective C.d.2: Facilities, equipment, and refuge lands would be maintained for potential use by researchers.

Basis of Objective: Same as Alternative C.
Strategies to Achieve Objective: Same as Alternative C.
Monitoring Elements: Same as Alternative C.

3.4.D.3 Anaho Island NWR

3.4.D.3.1 Management Program

Guiding principles and strategies for Anaho Island NWR would be the same as Alternative C.

3.4.D.4 Other Program Areas

The management of other programs would be carried out as described under Alternative A, as modified in Alternative C, and as further noted below.

3.4.D.4.1 Fire Management

The guiding principles, goals, objectives, and strategies of the fire management program would be similar to those outlined under Alternative A, except that prescribed burning would not be used under this alternative.

3.4.B.4.2 Other Public Uses

The only public uses that would be permitted on Stillwater NWR are those listed in refuge purposes and in the priority public uses identified in the Refuge System Administration Act. Nonwildlife-dependent public uses would not be permitted under this alternative.

3.4.D.4.3 Budget and Administration

Several projects have been identified for implementation under Alternative C. The largest would be a refuge administrative complex which would include a visitor facility and maintenance shop (an estimated $5,234,500 under this alternative). Other projects include development of additional public use facilities such as auto tour routes, nature trails, observation areas and interpretive signs (an estimated $6,446,400 under this alternative). Total capital costs of the water-rigths acquisition program are presented in the WRAP EIS (USFWS 1996a). Funding for these projects varies greatly depending on Congressional appropriations and the refuge's ability

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to obtain special project funds from sources such as grants, and Transportation Equity Act funds and, therefore, predicting the actual "nonsalary" funding is difficult.

The projected annual costs of managing the Stillwater NWR Complex under Alternative C would be an estimated $3.37 to $3.57 million/year upon completion of the water-rights acquisition program. Projected annual expenditures include salaries; refuge operation and maintenance costs; water delivery and operation and maintenance charges; refuge revenue sharing payments; and water-rights leasing costs. Annual expenditures related to the water-rights acquisition program were discussed in Section 3.3.1.1, Features and Assumptions Common to all Alternatives. Refuge salaries and operations and maintenance costs would be an estimated $1.77 million/year under this alternative.

Refuge staff under Alternative D would be similar to Alternative A, except two additional positions would be added: a park ranger (GS-9 law enforcement) and an Archaeologist (GS-9/11), bringing the total number of permanent full-time positions to fifteen, which is the same as Alternative C.

3.5 SUMMARY OF POTENTIAL IMPACTS OF THE ALTERNATIVES BEING CONSIDERED

Potential impacts of the alternatives being considered in this Draft EIS are presented in Table 3.3.

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Table 3.3. Summary of potential impacts of Alternatives A, B, C, and D.

Resource/Issue	**Existing Conditions**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
		Long-term Average Change from Existing Conditions[2,3]			
4.2[1] PHYSICAL ENVIRONMENT (EIS Study Area)					
4.2.2 Newlands Project (acre-feet)					
4.2.2.1 Irrigated Acreage Base (acres)	59,075	similar[2]	similar	similar	similar
4.2.2.2 Headgate Demand Deliveries	174,500 169,290	2.5% lower 1.8% lower	2.5% lower 1.9% lower	2.5% lower 1.7% lower	2.5% lower 1.4% lower
4.2.2.3 Project Efficiency (%)	64.8	2.6% higher (67.4%)	2.6% higher	2.6% higher	2.9% higher (67.7%)
4.2.2.4 Lahontan Reservoir Releases June 30 Storage November 30 Storage	261,100 216,160 108,070	5.5% lower 1% higher 4.0% higher	5.6% lower 2.3% higher 1.0% higher	5.4 lower 0.1% higher 6.9% higher	5.6% lower 3.7% lower 15.4% higher
4.2.2.5 Hydropower Resources Power (GWh) Revenue ($)	21,660 875,010	8.6% lower 8.9% lower	8.6% lower 11.0% lower	11.0% lower 22.0% lower	11.5% lower 12.2% lower
4.2.2.6 Newlands Project Canal Capacities	EC[3]	increase needed	similar	similar-MH	SH-MH
4.2.2.7 Truckee Canal at Derby Dam	88,250	15.7% lower	15.0% lower	16.3% lower	19.9% lower
4.2.3 Lower Truckee River at Derby Dam Pyramid Lake Elevation (feet)	475,660 3,836.9	2.8% higher 3.1 ft. higher	2.7% higher 2.6 ft. higher	2.9% higher 3.2 ft. higher	3.1% higher 3.6 ft. higher
4.2.4 Air Quality (micrograms/meter^3)	EC	111	similar	similar	similar
4.3 PHYSICAL ENVIRONMENT (ON REFUGE)					
4.3.1 Service Lands Acreage Base					
4.3.1.1 Stillwater NWR/WMA and Fallon NWR (acres)	163,021	no change	40% lower	16% lower	3% higher
4.3.1.2 Anaho Island NWR (acres)	EC (490 ac.in 1999)	245	<1% lower	<1% higher	2% lower
4.3.3 Refuge Wetlands					
4.3.3.1 Average Wetland-Habitat Acreage overall nonspill year, Stillwater Marsh only	8,000 6,600	75% higher (14,000) 90% higher (12,500)	75% higher 90% higher	75% higher 90% higher	75% higher 90% higher
4.3.3.2 Wetland deliveries and incidental inflows (ave.)	39,900	75% higher (70,000)	75% higher	75% higher	75% higher
4.3.3.3 Seasonal Wetland-Habitat Apr-Jun (Stillwater Marsh, nonspill year) Oct-Dec	6,700 6,800	87% higher 87% higher	95% higher 100% higher	153% higher 55% higher	183% higher 15% lower
4.3.3.4 Flushing Action Total Dissolved Solids Mercury	limited EC potential problem	limited BC[1] similar	similar similar similar	SH-MH[1] similar SH	SH-MH similar SH

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[1] Numbers along the left-hand side correspond to section numbers in Chapter 4.

[2] The estimated changes from baseline presented in this matrix were calculated for the sole purpose of illustrating differences in potential effects of each of the alternatives being considered.. The numbers are estimates only and are used as indices for assessing broad differences among alternatives.

[3] EC = existing conditions; BC = baseline conditions, SH = slightly higher than baseline conditions, MH = moderately higher than baseline, CH = considerably higher than baseline, SL = slightly lower than baseline, ML = moderately lower than baseline, CL = considerably lower than baseline.

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Table 3.3 (cont'd). Summary of potential impacts of Alternatives A, B, C, and D.

Resource/Issue	**Existing Conditions**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
		Conditions Resulting from Each Alternative			
4.4 BIOLOGICAL COMMUNITIES					
4.4.1 VEGETATION					
4.4.1.1 Marsh Plant Communities (Peak acreage / Season of Peak Acreage)[4]					
4.4.1.1.1 Submergent Vegetation	660-2,640 / similar	2,500-5,080 / similar	1,320-4,110 / similar	2,100-3,675 / similar	2,900-3,920 / similar
4.4.1.1.2 Deep Emergent Vegetation	990-1,980 /similar	1,875-3,750 / similar	1,980-5,010 / similar	2,550-4,200 / similar	2,610-2,850 / spring
4.4.1.1.3 Shallow Emergent Vegetation	660-2,310 / similar	1,250-3,125 / similar	1,320-4,110 / fall	1,050-5,100 / spring	0-6,860 / spring
4.4.1.1.4 Moist-Soil Vegetation	670-2,040 / fall	625-1,900 / fall	1,980-4,110 / fall	1,050-4,250 / spring	0-3,920 / spring
4.4.1.1.5 Wet Meadow Vegetation	0-1,360 / spring	0-1,250 / spring	660-2,060 / fall	1,050-4,250 / spring	0-5,700 / spring
4.4.1.1.6 Wetland Shrub Vegetation	0-330 / similar	0-625 / similar	0-411 / fall	0-850 / spring	0-980 / spring
4.4.1.1.7 Unvegetated Alkali Mudflat Habitat	330-660 / similar	625-1,250 / similar	660-1,370 / fall	525-2,550 / late spring	0-2,940 / late spring
4.4.1.1.8 Deep, Open-Water Habitat	0-67 / spring	0-125 / spring	0-132 / spring	105-680 / spring	116-980 / spring
4.4.1.1.9 Playa Habitats (excl. Carson Sink)	0-8,900 / spring	0-8,900 / spring	0-4,520 / spring	0-6,450 / spring	0-8,470 / spring
4.4.1.2 Riverine/Riparian Plant Communities	27 miles protected No restoration	27 miles protected Minimal restoration	4 miles protected Minimal restoration	30 miles protected Maximum restoration	30 miles protected High-level of restoration
4.4.1.3 Desert Shrub Plant Communities	57,400 acres protected Depleted understories	57,400 acres protected Depleted understories	20,900 acres protected Depleted understories	44,600 acres protected Enhanced understories	53,900 acres protected Enhanced understories
4.4.1.4 Agricultural Vegetation	0 acres	0 acres	300-400 acres alfalfa, small grains	200-300 acres alfalfa, small grains	0 acres
4.4.1.5 Composition of Plant Communities	65 % native species	65-70 % native species	similar proportion, but different species	moderately higher	moderately higher
4.4.1.6 Invasive Exotic Vegetation	Abundant and increasing distribution of saltcedar and tall whitetop in wetlands and along riparian corridors	similar	slightly to moderately lower distribution of saltcedar and tall white top in marsh and meadows, but similar in riparian	moderately lower distribution of saltcedar and tall whitetop in marsh, meadow, and riparian habitats	slightly to moderately lower distribution of saltcedar and tall whitetop in marsh, meadow, and riparian habitats

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[4] Seasonal ranges in vegetation acreages are a component of vegetation dynamics. This table considers only an estimated average peak acreage and the season when the peak would occur.

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Table 3.3 (cont'd). Summary of potential impacts of Alternatives A, B, C, and D.

Resource/Issue		**Existing Conditions**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
			Changes from Existing Conditions^{1,2}			
4.4.2 WILDLIFE (all estimates are for nonspill years)						
4.4.2.1 Birds						
4.4.2.1.1 Waterfowl	Waterfowl Use Days	8 - 10 million	75 -125% higher	125-175% higher	75-125% higher	10-20% lower
	Waterfowl Produced	3,000 - 5,000	similar to 150% higher	similar to 200% higher	100-200% higher	similar
4.4.2.1.2 Shorebirds	Peak Spring Population	50,000	MH-CH	MH-CH	CH	CH
	Breeding Population	EC	MH-CH	MH-CH	CH	CH
	Fall Migration	25,000-50,000	100% higher	100% higher	100-125% higher	125-150% higher
4.4.2.1.3 Wading Birds	Migratory Population	EC	MH-CH	MH-CH	CH (spring) MH (fall)	CH (spring) similar (fall)
	Breeding Population	EC	MH-CH	MH-CH	CH	CH
4.4.2.1.4 White pelicans nests/year on Anaho Island		2,000 - 5,000	similar	similar	similar	similar
4.4.2.1.5 Other Waterbirds	Spring	EC	MH	MH	CH	CH
	Fall	EC	MH	MH	MH	similar
4.4.2.1.6 Passerines	Riparian	EC	similar	similar	SH- MH	SH-MH
	Upland	EC	similar	similar	similar to SH	similar to SH
4.4.2.1.7 Raptors	Bald Eagles (winter)	up to 30	SH	SH-MH	SH	similar to SL
	Marsh Raptors	EC	MH	MH	MH-CH	CH-MH
	Riparian/Upland Raptors	EC	similar	similar	SH-MH	SH-CH
4.4.2.1.8 Other Bird Species		EC	similar	similar - SH	SH	SH
4.4.2.1.9 Avian Diseases	number birds lost /year	1,000 - 10,000	similar	similar	similar	similar - SL
4.4.2.2 Mammals	Marsh	EC	SH-MH	SH-MH	M H	SH-MH
	Riparian	EC	similar	similar	MH	SH-MH
	Upland	EC	similar	similar	SH	SH
4.4.2.4 Reptiles		EC	similar	similar	SH	SH
4.4.2.4 Amphibians		EC	similar	similar	similar - SH	SH-MH
4.4.2.5 Fish	Native	EC	MH-CH	MH-CH	CH	SH-MH
	Game Fish (non-native)	EC	CH	MH-CH	MH-CH	similar
	Carp and Mosquito Fish (non-native)	EC (common-abund't)	MH	SH(carp), MH(m. fish)	SH(carp), MH(m. fish)	similar
4.4.2.6 Invertebrates	Aquatic (Diversity/Abundance)	Moderate/High	SH/similar to SH	SH/similar to SH	SH-MH/similar to SH	MH/similar
	Riparian (Diversity)	EC	similar	similar	SH - MH	SH - MH
	Dune (Abundance)	EC	similar	similar	similar	similar
4.4.2.7 Endangered/Threatened Species	On-refuge	EC	similar	similar	similar	similar
	Truckee River basin (cui-ui index[5])	692,200	75% higher	74% higher	84% higher	97% higher
	Truckee River basin (Lahontan cutthroat trout)	EC	SH	SH	SH	SH
4.4.2.8 Fish and Wildlife Toxicity		EC	similar	similar	similar	similar
Natural Biological Diversity		EC	SH-MH	similar - MH	MH	similar to SH

[5] The cui-ui index is a modeled estimate that refers to the number of adult female cui-ui at the end of a 95-year simulation period.

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Table 3.3 (cont'd). Summary of potential impacts of Alternatives A, B, C, and D.

Resource/Issue	Existing Conditions	Alternative A	Alternative B	Alternative C	Alternative D
		Changes from Existing Conditions[1,2]			
4.5 RECREATIONAL OPPORTUNITIES					
4.5.1 Hunting	EC	MH-CH	MH-CH	Option 1 SH than EC Option 2 MH than EC	similar to ML
4.5.2 Environmental Education and Interpretation	600-800 individuals reached/year through leader-cond'd activities	similar	SH	MH	CH
4.5.3 Wildlife Observation and Photography	EC	SH-MH	SH	SH-MH	MH
4.5.4 Fishing Stillwater Marsh Indian Lakes	EC (very few anglers) EC	SL BC (similar to EC)	SL similar	SL similar	SL similar
4.5.5 Camping	EC	similar to SH	ML	ML	ML
4.5.6 Other Uses Stillwater Marsh/Fallon NWR area Stillwater WMA area	EC EC	similar similar	ML similar	SL ML	SL ML
4.6 CULTURAL RESOURCES/INDIAN TRUST ASSETS					
4.6.1 Cultural Resources	Cultural resources adequately protected	similar	SH (increased law enforcement)	MH (law enforcement, education, and more info)	MH (law enforcement, education, and more info.)
4.6.2 Indian Trust Assets					
4.6.2.1 Fallon Paiute-Shoshone Indian Reservation	EC	similar	similar	similar	similar
4.6.2.2 Pyramid Lake (refer to Truckee River, Pyramid Lake and cui-ui resources addressed earlier	EC	SH	SH	SH	SH
4.7 COMMERCIAL HARVEST OF RESOURCES					
4.7.1 Livestock Grazing On lands retained by Service Total (incl. lands not retained by Service)	7,200 AUMs 7,200 AUMs	similar similar	60-80% lower 20-30% lower	90-95% lower 37-47% lower	100% lower 40-50% lower
4.7.2 Muskrat Trapping (number trapped annually)	4,000 - 40,000	similar	similar	90% fewer	100% fewer
4.7.3 Commercial Fishery (Indian Lakes area)	Carp and Blackfish	similar	similar	similar	similar
4.8 SOCIOECONOMIC RESOURCES					
4.8.4 Commercial Use Revenues	$68,200-124,000/year	$68,200-124,000/year	10-25% lower	40-65% lower	45-75% lower
4.8.5 Outdoor Recreation Expenditures	EC	$740,000/year	1% higher	17% higher	5% higher
4.8.6 Total Contribution to Local Economy[b]	EC	$1,675,000/year	0.9-1.7% lower	5.2-11.8% higher	2.3-9.5% lower
4.9 NAVAL AIR STATION-FALLON OPERATIONS	EC	similar	similar	similar	similar
4.10 EFFECTS ON REFUGE MANAGEMENT					
4.10.1 Habitat Management Tools Tools available Frequency of use Constraints on use (beyond laws and policy)	Large number Low-moderate Few	Large number Low-moderate Few	similar SH - MH SH	similar SH - MH MH	ML SL - similar MH
4.10.2 Ability of the Service to Meet Legal Mandates	Limited	Limited	SL	CH	MH

[b] Does not include factors such as reductions in revenues from hydroelectric power generation

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CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter describes the existing and baseline environmental resources of the EIS study area and identifies and provides an evaluation of the potential environmental impacts of the alternatives, described in Chapter 3, on these resources. For each resource, existing and baseline conditions are described, followed by a comparison of how each alternative would affect the resource, as compared to baseline and existing conditions. This chapter only addresses the environmental resources in the study area that could be affected by one or more of the alternatives, not the entire existing environment.

The environmental characteristics of both basins have been thoroughly described in three recent environmental documents that are incorporated by reference: WRAP EIS (USFWS 1996a); *Draft Environmental Impact Statement Truckee River Operating Agreement* (USDI 1998); and *Environmental Assessment Adjusted 1988 Newlands Project Operating Criteria and Procedures* (*Federal Register, Vol. 61, No. 237, 64815 - 64958*; cited as USBOR 1997). These publications were used extensively in describing baseline conditions in this chapter, and information has been updated where necessary.

Environmental consequences are direct and indirect impacts (positive or negative) that would result from the action alternatives. Direct consequences are those that are caused by the action, and occur at the same time and place. Indirect consequences are also caused by the action, but occur later in time or are further removed from the action. In addition to assessing the potential impacts on the environment, an assessment of the effects of the alternatives on the Service's capability to meet relevant legal mandates has been made.

The evaluation in this chapter includes the potential consequences of alternatives on Newlands Project operations and other environmental resources in the Draft EIS study area; physical components of the refuge complex environment (e.g., water resources); fish, wildlife, plants, and their habitats; public uses on the refuge complex; cultural resources and Indian trust assets; Naval Air Station-Fallon operations; and the local socioeconomy. Also assessed is the Service's ability to meet relevant legal and policy mandates under each alternative and potential limitations of the alternatives on a refuge manager's ability to manage. At the end of the chapter, cumulative effects are summarized, and other impacts, including conflicts with Federal, State and local policies or plans, as well as unavoidable and irretrievable effects of the alternatives are discussed.

The following resources were examined during scoping and the impact analysis process and found not to be affected by any of the alternatives: geology, climate and meteorology, groundwater, and secondary wetlands.

4.1.1 Definitions of Existing and Baseline Conditions

Assessments were made of the potential effects of alternatives on existing and baseline conditions. Existing conditions are those conditions that exist now and that existed in the recent past, or that could happen in the near future with the continuation of existing management on the Stillwater NWR Complex and land-use practices outside the complex. Existing conditions assume that the 20,000 acre-feet of water rights acquired for Stillwater NWR have been transferred to wetlands and that 17,000 acre-feet are available for wetland use on the refuge. However, at present, only about 7,900 acre-feet of water rights are permitted for delivery to the wetlands. The other acquired water rights are either under protest, recently filed, or pending application. Therefore, the existing conditions identified in this Draft EIS are overstated with respect to actual existing conditions. Due to the high year-to-year variability and the early stages of the water-rights acquisition program, the existing hydrologic conditions presented in this Draft EIS are modeled conditions and are used to estimate changes in environmental conditions due to changes in management that would occur under different alternatives.

Baseline conditions those conditions that would result from continued operation under Alternative A (No Action Alternative) and existing land-use practices outside of the refuge complex. Therefore, they are the same as existing conditions except as affected by the ongoing water-rights acquisition program. Whereas existing conditions are limited to the volume of water rights that have been acquired to date, baseline conditions assumes: (1) completion of the water-rights acquisition program detailed in Alternative 5 of the WRAP EIS and ROD (USFWS 1996a,b) and associated effects, including a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR, and (2) that the Newlands Project 1988 OCAP efficiency targets, as adjusted in 1997 (USBOR 1997), have been fully achieved. Baseline conditions also assume that a long-term average of 25,000 acres of wetland-habitat will be maintained at Stillwater NWR (14,000 acres, as identified above), Carson Lake (10,200 acres), and the Fallon Paiute-Shoshone Indian Reservation (800 acres). Baseline conditions assume that Anaho Island NWR will be managed as it has been in the recent past.

Because baseline conditions assume the completion of the water-rights acquisition program, these conditions are not anticipated to occur for another 15 to 20 years or more. Therefore, the changes from existing conditions to each alternative are presented. For each action alternative, this percent change is compared with the percent change estimated to occur under the No Action Alternative. This is done to give readers an indication of the difference in change that would occur under the No Action Alternative (Alternative A) as compared to the action alternatives. With respect to the water-rights acquisition program, the effects of Alternative A have already been analyzed in the WRAP EIS (USFWS 1996a).

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4.1.2 Use of Supportive Information

Many sources of information were used in evaluating the potential effects of the alternatives on the resources addressed in this chapter, including inventories of vegetation and wildlife; analyses of wildlife, habitat, and public monitoring data; scientific literature; computer modeling; staff reports; geographic information system (GIS) analysis; socioeconomic analyses; and professional judgement.

Rather than providing extensive references to scientific and other information in this chapter, readers are referred to technical appendices. Two literature reviews were conducted to address to sources of effects on wildlife and their habitat: potential effects of human disturbance (Appendix L) and potential effects of livestock grazing on wildlife and habitat (Appendix M). Another report included as an appendix identifies the major underlying problems limiting achievement of refuge purposes and summarizes pertinent scientific literature on the effects of these underlying problems (Appendix N). Evaluations of the alternatives on vegetative communities, and resulting populations of wildlife, relied on a spreadsheet model designed to estimate monthly wetland-habitat acreages under each alternative under several different representative water years, or stages of the water-rights acquisition program (Appendix I). The seasonal delivery patterns in the alternatives were based on different sets of assumptions and were designed to meet different needs (Appendix H). Appendix H presents the development of monthly inflow figures for each alternative for several representative years. Compatibility determinations in Appendix O can be consulted for more detailed information on the potential effects of public uses, livestock grazing, and farming practices on wildlife and habitat.

Existing and baseline hydrologic conditions were modeled for a variety of reasons including: (1) the water-rights acquisition program is new and ongoing (no long-term data is available on trends), (2) only about half of the acquired water rights are presently available for delivery to the wetlands, and (3) the hydrology in the Great Basin is highly variable. Effects that alternative Stillwater NWR water-delivery schedules could have on key elements of Newlands Project operations, Carson Division resources associated with Newlands Project water, and lower Truckee River resources were estimated using the Below Lahontan Reservoir model. The model used U.S. Bureau of Reclamation supplied water data for a 95-year hydrologic simulation of the Carson and Truckee Rivers. The model therefore provides the ability to apply existing, baseline, and alternative water-management scenarios to historical hydrologic data, which allowed long-term monthly and annual averages to be calculated for comparative purposes.

A spreadsheet model was designed to estimate monthly wetland-habitat acreages on Stillwater NWR that would be produced by each of the alternative seasonal patterns of inflow. The model was used to estimated monthly and annual average wetland-habitat acreages for several representative water years, including a full-allocation year at the completion of the water-rights acquisition program, the acquisition of 20,000 acre-feet of water rights for Stillwater NWR, and a typical spill year. This model was used solely to compare gross differences in seasonal wetland-habitat acreages among alternatives.

4.2 PHYSICAL ENVIRONMENT — STUDY AREA

4.2.1 Water Supply

4.2.1.1 Water Quantity

Total water supply in both the Carson River and Truckee River basins consists of surface water and groundwater sources. Because supply depends, in large part, on precipitation falling in the Sierra Nevadas, total supply in the basins varies annually. Potential effects on groundwater and secondary wetlands were not identified as an issue for this planning effort and no potential effects were identified with respect to the actions being evaluated in this Draft EIS. Therefore, additional information is not provided on these resources and readers are referred to the WRAP EIS for this information.

Carson River flows, recorded at the Fort Churchill gaging station since 1912, have averaged about 289,820 acre-feet per year. Flow volumes have varied widely during the period of record, with a high annual flow at Fort Churchill of 804,300 acre-feet (1983 water year) and a low annual flow of 26,300 acre-feet (1977 water year). In the absence of any diversions or water control structures during the period of record, an estimated average of about 410,000 acre-feet would have flowed past Fort Churchill into the Lahontan Valley (Kerley et al. 1993). The flow volumes under these natural conditions would have ranged from an estimated low of 90,000 acre-feet (1977 water year) to an estimated high of about 940,000 acre-feet (1983 water year).

Currently, the Carson River channel downstream from Lahontan Reservoir is used to convey irrigation water, drainflows, and spills. The natural hydrologic cycle of the river flow downstream from Lahontan Dam has been altered and is now primarily controlled by the Newlands Project operations. The present-day pattern of Lahontan Valley hydrology, including that of Stillwater NWR and Fallon NWR, is dominated by the effects of more than 80 years of surface water irrigation.

Surface water released from Lahontan Reservoir for irrigation is distributed throughout the Carson Division by approximately 381 miles of irrigation canals. The volume of water delivered through the irrigation system varies daily depending on weather, amount of farmland being irrigated, and groundwater elevation. Annually, delivery volumes vary depending on available water supply and number of irrigated acres. The Truckee-Carson Irrigation District Water Master is responsible for scheduling Newlands Project irrigation deliveries.

Drainwater consists of runoff from farm fields (return flows) and groundwater seepage into drains. Drainflow volume to the wetlands changes from year to year depending on Newlands Project delivery efficiency, the irrigated acreage base, and Lahontan Reservoir releases. Prior to the acquisition of water rights for wetlands, drainwater was the only water entering Lahontan Valley wetlands during most years (all years except those when excess or spill-water was released from Lahontan Reservoir during high-water years). Upon completion of the water-rights acquisition program, it is anticipated that drainwater will comprise an annual average of about 16 percent of wetland inflow. During extreme droughts, drainflows do not reach the wetlands.

Surface water resources in the study area are subject to the high evaporative loss rates of the desert climate. Lahontan Reservoir, other Newlands Project regulating reservoirs, and the primary wetland areas show evaporative losses of 60 or more inches per year. The long-term average (1940 to 1990) evaporative loss rate for Fallon is 53 inches per year. Evaporation rates in wetland areas differ from readings in town and are generally 5 to 30 percent higher in May, June, and July based on preliminary data collected at Stillwater NWR and Carson Lake. One explanation for these higher evaporation rates is that the primary wetlands are adjacent to, and downwind of, large expanses of dry, sparsely vegetated, desert land. The hot, dry winds from these areas may increase evaporation rates above those recorded at the University of Nevada Agriculture Station monitoring site, which is adjacent to irrigated farm fields near Fallon.

Surface runoff of precipitation is the primary source of water supply in the Lower Truckee River basin. Most of the available water supply is generated upstream of the USGS stream gaging station at Farad, California, and is produced primarily during the spring runoff season (generally April-July) by the melting snowpack in the Sierra Nevadas. Annual streamflow recorded at Farad has ranged from a low of 133,460 acre-feet in 1931 to a high of 1,768,980 acre-feet in 1983. Average annual streamflow at Farad is about 543,400 acre-feet.

Truckee River flows are controlled by several reservoir operations, including Boca, Donner, Lake Tahoe, Stampede, and Prosser Reservoirs. Under baseline conditions, an estimated average of 563,500 acre-feet ~~per year~~ will flow down to the ~~Derby Dam~~. ~~An estimated 74,410 acre~~-feet per year will be diverted to the Truckee Canal and the remainder will flow past Derby Dam, most of which will flow downstream to Pyramid Lake. There will be an estimated average annual inflow rate of about 496,700 acre-feet of water flowing into Pyramid Lake each year.

Water demands and allocations of Truckee River water are complex. These resources above Derby Dam would not be affected by implementation of any of the alternatives considered in this Draft EIS and therefore are not addressed in detail. For further information, readers are referred to the Adjusted OCAP (*Federal Register, Vol. 61, No. 237, 64815 - 64958*) and associated EA (USDI 1997) and the Truckee River Operating Agreement Draft EIS (USDI and State of California 1998) for further information.

Prior to the construction of the Newlands Project and other water diversions from the Truckee River, the water surface of Pyramid Lake was at a much higher elevation than it is today. The lake level remained relatively stable, with inflow and evaporation about equal. In 1870, the lake level was about 3,887 feet in elevation. The lake level began to decline in 1910 due to upstream diversions. By 1967, the elevation reached a low of 3,784, a 100-foot drop in elevation. The 1988 OCAP (USBOR 1988), as adjusted in 1997 (USBOR 1997), are anticipated to result in the water surface of Pyramid Lake stabilizing at about 3,841 feet, within 50 feet of its pre-1900 elevation. In July 1997, the elevation of the water surface was about 3,809 feet.

4.2.1.1 Water Quality

Although none of the actions proposed in this Draft EIS would affect water quality outside the refuge complex, this section was included to provide background on the sources of constituents found in water entering Stillwater NWR, Stillwater WMA, and Fallon NWR. In this Draft EIS, care was taken in using the term water quality because high-quality water to one group of wildlife species is poor quality to another group of species, and visa versa. In some cases, the term water chemistry was used as a neutral term, so as not to imply "high quality" or "low quality." There is no one set of criteria that identifies high-quality water for wildlife in a Great Basin wetland complex. Fresh water having a neutral pH level and few dissolved solids, which has come to be synonymous with high-quality water, provides high-quality water conditions for wildlife and plant species associated with fresh water, such as in the historic Carson River and wetlands at its delta. However, these water conditions provide poor conditions for the many other wildlife and plant species associated with water having high concentrations of total dissolved solids or a more basic (alkaline) pH, such as at the lower end of the wetland complex that the Carson River empties into (e.g., Carson Sink, off-channel areas of the historic Stillwater Marsh). This large gradation of water chemistry from fresh water to very highly alkaline or saline is characteristic of many Great Basin wetland complexes. This aspects of water chemistry (total dissolved solids in the water and pH levels) is a different issue than environmental contaminants.

The Carson River from Lahontan Reservoir to the Carson Sink and Stillwater Marsh are classified as Class C waters of the State (Nevada Administrative Code 445A.126). Beneficial uses for class C waters include: municipal or domestic supply, or both, following complete treatment, irrigation, watering of livestock, aquatic life, propagation of wildlife, recreation involving contact with the water, recreation not involving contact with the water, and industrial supply. Water quality standards for these beneficial uses are given in Table 4.1. Table 4.1 also provides water quality criteria recommended by the EPA, but not adopted by the State. Concentrations of ammonia, chloride, dissolved solids, pH, sodium, and the trace elements arsenic, boron, copper, mercury, and molybdenum commonly exceed Federal criteria and State standards for the protection of aquatic life or the propagation of wildlife and/or concentrations associated with adverse effects to aquatic organisms and wildlife. Water in certain drains entering Stillwater NWR was found to be toxic to aquatic invertebrates and fish larvae. Toxicity was not attributed to a single element, but appeared to be related to a mixture of dissolved constituents, including arsenic, boron, lithium, molybdenum, and total dissolved solids.

The chemistry of water varies with source. Water released from Lahontan Reservoir is generally fresh, but may contain elevated concentrations of mercury. The highest concentrations of dissolved solids, arsenic, boron, molybdenum, and ammonia are typically found in agricultural drainage water. The concentrations of constituents in agricultural drainwater vary seasonally. In general, the highest concentrations, and presumably the greatest potential for toxicity, are found prior to the irrigation season. Concentrations of dissolved constituents decline as drain flow volumes increase through the irrigation season. However, because of increased drain flows, the largest contaminant loads in drainwater typically enter Stillwater NWR later in the irrigation season. In arid areas, persistent contaminants may accumulate and become concentrated in

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Table 4.1. Regulatory standards applicable to designated waters in Nevada. Standards are from Nevada Administrative Code (NAC) 445A.119 and 445A.144.

Constituent	Municipal Or Domestic Supply	Propagation of Aquatic Life		Irrigation	Watering Of Livestock	Propagation Of Wildlife
		1-hour Avg.	96-hour Avg.			
pH	5.0 -9.0	6.5 -9.0	6.5 - 9.0	4.5 - 9.0	5.0 - 9.0	7.0 - 9.2
TDS (mg/L)	500	-	-	-	3,000	-
Ammonia (mg/L)	0.5	^{a}	^{a}	-	-	-
Chloride (mg/L)	250	-	-	-	1,500	1,500
Sulfate (mg/L)	250	-	-	-	-	-
Aluminum (μg/L)	-	750^{a}	87^{a}	-	-	-
Arsenic (μg/L)	50	342^{b,c}	180^{b,c}	100	200	-
Barium (μg/L)	1,000	-	-	-	-	-
Beryllium (μg/L)	0	-	-	100	-	-
Boron (μg/L)	-	-	-	750	5,000	-
Cadmium (μg/L)	10	^{c,d}	^{c,d}	10	50	-
Chromium (μg/L)	-	^{c,d}	^{c,d}	100	1,000	-
Total						
Chromium+6						
Chromium+3						
Copper (μg/L)	-	^{c,d}	^{c,d}	-	-	-
Fluoride (μg/L)	-	-	-	1,000	2,000	-
Iron (μg/L)	-	1,000	1,000	5,000	-	-
Lead (μg/L)	50	^{c,d}	^{c,d}	5,000	100	-
Manganese (μg/L)	-	-	-	200	-	-
Mercury (μg/L)	2	2^{c}	0.012	-	10	-
Molybdenum (μg/L)	-	19	19	-	-	-
Nickel (μg/L)	13.4	^{c,d}	^{c,d}	200	-	-
Selenium (μg/L)	10	20	5	20	50	-
Silver (μg/L)	50	^{c,d}	^{c,d}	-	-	-
Zinc (μg/L)	-	^{c,d}	^{c,d}	2,000	25,000	-

[a] Aquatic life criterion recommended by the U.S. Environmental Protection Agency. Ammonia criteria depend on pH. A pH range from 8 and 9 corresponds to a Criteria Maximum Concentrations (1-hour average) between 1.3 and 8.4 mg/L and a Criteria Continuous Concentration (96-hour average) between 0.25 and 1.27 mg/L.

[b] The arsenic standards for aquatic life are specific for As+3.

[c] The standard applies to dissolved fraction only.

[d] Standards for aquatic life are based on water hardness (H), which is expressed as mg/L $CaCO_3$. Formulae are as follows:

Cadmium:	1-hour:	0.85exp[1.128 ln(H)-3.828]
	96-hour:	0.85exp[0.7852 ln(H)-3.490]
Chromium(+3):	1-hour:	0.85exp[0.8190 ln(H)+3.688]
	96-hour:	0.85exp[0.8190 ln(H)+1.561]
Copper:	1-hour:	0.85exp[0.9422 ln(H)-1.464]
	96-hour:	0.85exp[0.8545 ln(H)-1.465]
Lead:	1-hour:	0.50exp[1.273 ln(H)-1.460]
	96-hour:	0.25exp[1.273 ln(H)-4.705]
Nickel:	1-hour:	0.85exp[0.8460 ln(H)+3.3612]
	96-hour:	0.85exp[0.8460 ln(H)+1.1645]
Silver		0.85exp[1.72 ln(H)-6.52]
Zinc:	1-hour:	0.85exp[0.8473 ln(H)+0.8604]
	96-hour:	0.85exp[0.8473 ln(H)+0.7614]

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wetlands through evaporative processes. At times concentrations may reach toxic levels. Wetlands in closed hydrographic basins, such as Lahontan Valley, are particularly susceptible to contaminant accumulation and concentration. The occurrence of such effects and the potential to adversely affect fish, wildlife, and habitat quality on Stillwater NWR are discussed under Section 4.3.3.5.

The historic release of mercury to the Carson River continues to affect the quality of water conveyed to Stillwater NWR, particularly during large upriver flood events, although questions still exist on the actual effects that mercury contamination is having on refuge wildlife. Between 1859 and 1900, elemental mercury was used during gold and silver ore milling operations in the Comstock Mining District in the Virginia Mountain Range approximately 70 miles west of Stillwater NWR. As much as 7,500 tons of mercury may have been lost during milling operations. Most was discarded in mill tailings or discharged to the Carson River or its tributaries in mill effluent. Mercury has since become widely distributed in the lower Carson River basin.

Mercury has an affinity for particulate material. As a result, the bulk of the mercury in aquatic system is typically found in sediment. Transport of mercury in the Carson River basin largely occurs through the transport of sediments and suspended solids. In Lahontan Valley, the highest mercury concentration in aquatic sediment generally correspond to Carson River channels that existed after 1860 and the construction of Lahontan Dam in 1915, suggesting that mercury was deposited prior to construction of the dam. However, elevated mercury concentrations in Stillwater Point Reservoir, Newlands Project reservoirs, and other wetlands created after construction of Lahontan Dam indicate that transport and redistribution of mercury continued after 1915. Certain agricultural drains, such as Diagonal Drain and Stillwater Slough, incorporate sections of these historic river channels. As a result, mercury is frequently detected in the water column of the drains. High mercury concentrations have also been detected in D-Line Canal. Aquatic sediment may act as both a sink and a source of mercury. In Lahontan Valley, mercury concentrations in the water and biological samples generally correlate with concentrations in sediment.

Large amounts of mercury may be mobilized from river banks and stream bed sediments during flood events. In 1997, the USGS estimated that 10,000 pounds of mercury entered Lahontan Reservoir during an exceptionally large flood. The bulk of the mercury was the direct result of flooding in January of that year. Between January and September, 1997, an estimated 2,000 pounds was released from Lahontan Dam and available for transport to wetlands in the Lahontan Valley.

Pesticides, especially herbicides, are used in some cases in the Newlands Project. However, information on pesticide concentrations in water delivery canals and drains is sparse. One investigation detected pesticides in the majority of water samples (17 of 19) collected from agricultural drains. The herbicides atrazine, simazine, and prometon were the most frequently detected pesticides (79, 68, and 47 percent of the samples, respectively). Concentrations were less than levels associated with mortality. This investigation was conducted in August, when heavy use of herbicides would not be expected. The aquatic herbicide, acrolein, is used to control submergent and emergent vegetation in Newlands Project water delivery canals.

Although this herbicide is highly toxic to aquatic organism, it is not persistent in aquatic systems (the half-life ranges from 14- to 92-hours, depending of temperature and pH). The Truckee-Carson Irrigation District has indicated that acrolein is only applied to waters delivered to agricultural field, and not to water delivered to wetlands. It is uncertain if acrolein enters Stillwater NWR in supply water through direct or indirect routes.

Sewage effluent and confined animal feeding operations have been identified as significant sources of nutrients, especially nitrogen and phosphorus, dissolved constituents (calcium, sodium, magnesium, iron, and sulfur), suspended solids, and pathogens in aquatic systems. Domestic septic systems located near agricultural drains may also represent potential sources of these constituents. The City of Fallon and the Naval Air Station-Fallon are permitted to discharge treated sewage effluent to drains entering Stillwater NWR Under the Clean Water Act and the Nevada Water Pollution Control Law, dischargers are required to comply with water quality standards and permit conditions. An unknown number of confined animal feeding operations are located near or adjacent to drains entering Stillwater NWR. EPA is currently developing policy for controlling the quality of drainage from confined animal feeding operations.

The accidental release of a hazardous or otherwise toxic material to the Carson River or surface water routes entering Stillwater NWR has the potential to adversely affect fish, wildlife, or habitat quality on Stillwater NWR. However, the highly controlled water delivery system offers an opportunity to prevent or otherwise control such materials entering Stillwater NWR. The successful management of an accidental release would require timely recognition and notification of the release and close coordination with emergency response personnel to ensure adequate consideration of fish and wildlife resource. Advanced emergency response planning would increase the possibility of successfully managing a toxic release to avoid adverse impacts to Stillwater NWR.

4.2.2 Newlands Project Operations and Infrastructure

This section presents a comparison of the potential consequences of the action alternatives on various aspects of Newlands Irrigation Project (Newlands Project) operations and infrastructure. The Service relied on calculations from the Below Lahontan Reservoir Model to make these analytical comparisons. The Below Lahontan Reservoir Model used a 95-year hydrologic simulation period to estimate long-term averages for each alternative.

Except where noted, mitigation measures were not identified in the following sections because none of the action alternatives would have no significant impacts on Newlands Project operations and infrastructure.

4.2.2.1 Newlands Project Irrigated Acreage Base

No adverse impacts to the irrigated acreage base would be anticipated. Lands that would remain in production on Stillwater NWR under Alternatives B and C would maintain slightly more farmland acreage in the Carson Division of the Newlands Irrigation Project compared to baseline conditions, but would not increase the farmland acreage that is irrigated in any given year. This is because water rights would have to be temporarily transferred to farmland on Stillwater NWR, and thus would result in a temporary change in the point of use, not an increase in irrigated acreage.

4.2.2.2 Newlands Project Headgate Demand and Deliveries

Newlands Project water rights are primarily used for agriculture and for wetlands protection and enhancement. This does not include other non-water-righted uses of Carson River water, such as the natural functioning of river, riparian, and marsh wetlands and their associated biological communities along the lower Carson River, nor does it account for recreational use and intrinsic values of the river system. Hydropower generation occurs at Lahontan Dam but is incidental to normal project operations.

Irrigation deliveries in the Newlands Project represent the primary water demand in Lahontan Valley. Newlands Project deliveries are based on the number of acres of land to be irrigated, the headgate entitlement (i.e., bench, bottom, pasture, or wetland), and the actual requests for irrigation water by the different water users. Where the number of irrigated acres in the Newlands Project varies from year to year, current data indicate the number of irrigated water-righted acres is about 59,000 (Table 4.2).

Table 4.2. Baseline Newlands Project irrigation acreage for purposes of this EIS.

	Farmland[A]	Wetland[B]	Total[C]
Carson Division	34,055	21,020	55,075
Truckee Division	4,000	0	4,000
Total (Newlands Project)	38,055	21,020	59,075

[A] Figures in this column derived from the 10/2/97 run of the Below Lahontan Reservoir model.

[B] This column designates the estimated number of acres from which water rights will be acquired for Lahontan Valley wetlands, obtained from the WRAP EIS/ROD (USFWS 1996 a, b). This figure does not represent the acreage of primary wetland-habitat to be maintained in the Lahontan Valley.

[C] Obtained from the Adjusted Operating Criteria and Procedures EA (USDI 1997).

Under baseline conditions, Carson Division demand at Lahontan Reservoir is 251,900 acre-feet/year while Truckee Division demand is 23,000 acre-feet annually. Carson Division water users receive, at their headgates, an average annual supply of 97.8 percent of their headgate demand. Truckee Division averages 98.7 percent of demand and is not expected to experience a substantial change with the actions being evaluated in this Draft EIS.

Most of the water available to serve Carson Division is supplied by the Carson River, which provides an average volume of approximately 289,800 acre-feet annually to Lahontan Reservoir. Water from the Truckee River is diverted at the Derby Diversion Dam, in accordance with provisions of OCAP, as necessary to meet Truckee Division demands and to supplement Carson River flows to satisfy Carson Division demands. Differences between baseline conditions of Alternative A in this Draft EIS and the estimated outcome of Alternative 5 presented in the WRAP EIS (USFWS 1996a) are in part due to adjustments made to OCAP (USBOR 1997).

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Headgate demand and delivery are based on acres of irrigated land, headgate entitlements, irrigation use rates, and requests for irrigation water. Under existing conditions, the Carson Division headgate demand is estimated to be 174,500 acre-feet. Upon completion of the water-rights acquisition program (WRAP EIS), a headgate demand of 170,100 acre-feet/year would be the same for all alternatives (Table 4.3). Under all alternatives, headgate deliveries are lower than the entitlement and irrigation demand due to shortages resulting from changing hydrologic conditions, climatic factors, and from water rights that go unused. Under all of the action alternatives, Truckee Division demands and deliveries are assumed to remain unchanged from the No Action Alternative. Figures in Table 4.3 assume no winter deliveries under Alternative C, but the results of analyses are discussed in the text.

Table 4.3 Potential effects of alternative water delivery schedules on Carson Division of the Newlands Irrigation Project parameters, based on Below Lahontan Reservoir Model results.

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
Headgate Demand (AF)	174,500	170,100	170,100	170,100	170,100
Headgate Delivery (AF)	169,290	166,310	166,130	166,430	166,900
Shortage (%)	3.00	2.22	2.33	2.16	1.88
Project Efficiency (%)	64.8	67.4	67.4	67.4	67.7
Demand Distribution[A] (% of annual demand)					
March	2	2	0	7	2
April	10	10	11	10	11
May	18	18	15	16	22
June	17	17	15	15	19
Total	47	47	41	48	54

Source: Below Lahontan Reservoir Model results

[A] Carson Division demand distribution for Lahontan Reservoir storage target calculations

Alternative A: Carson Division headgate deliveries under baseline conditions are calculated to be 166,310 acre-feet/year, which is an estimated decline of 1.8 percent from existing conditions (already evaluated in the WRAP EIS). Average shortages due to hydrologic factors, such as drought, are estimated to be about 2.2 percent under this alternative (Table 4.3).

Alternative B: Under this alternative, Carson Division headgate deliveries would be similar to those under Alternative A, the No Action Alternative. This alternative would result in an estimated 1.9 percent decline in headgate deliveries from existing conditions, comparable to the 1.8 percent decline estimated for the No Action Alternative. Reduced headgate deliveries under this alternative is caused by a higher Carson Division demand after Lahontan Reservoir fills (see

Section 4.2.2.4, below), as compared to Alternative A, which results in less carryover going into a potential drought.

Alternative C: As with alternative B, Carson Division headgate deliveries would be similar to Alternative A. This alternative would result in an estimated 1.7 percent decline in headgate deliveries from existing conditions, which is comparable to the 1.8 percent decline estimated for the No Action Alternative. A slightly higher estimated headgate delivery under Alternative C, as compared to Alternative A, is a consequence of a higher delivery volume for the Carson Division earlier in the year, which results in more carryover going into a potential drought. It is estimated that an even higher, albeit slight, headgate delivery for the Carson Division would result from delivering water to Stillwater NWR between mid-November and mid-March (as outlined in Chapter 3).

Alternative D: Under this alternative, it is estimated that Carson Division headgate deliveries could be slightly lower than they would under the No Action Alternative. This alternative would result in an estimated 1.4 percent decline in headgate deliveries from existing conditions, which is comparable to the 1.8 percent decline estimated for the No Action Alternative. Similar to Alternative C, the higher levels of early season deliveries results in more carryover going into a potential drought, coupled with higher efficiencies associated with winter deliveries occurring under this alternative.

4.2.2.3 Newlands Project Efficiency

Changes in efficiency involve a complexity of factors, such as distance, timing, frequency, routing, and dispersal of water-righted deliveries relative to Lahontan Reservoir releases. Another factor is the seasonal pattern of deliveries in the Carson Division. Because the different alternatives explored in this Draft EIS include different delivery schedules for Stillwater NWR, and because Stillwater NWR will have a large portion of the water rights in the Carson Division, the seasonal delivery pattern has the potential to affect the efficiency of the Newlands Project.

The Below Lahontan Reservoir Model estimates Newlands Project efficiency based upon a systematic comparison of physical and hydrologic parameters, including monthly delivery schedules. The Below Lahontan Reservoir Model results offer a long-term estimate of the end result and impacts of the various alternatives upon Newlands Project efficiency.

Alternatives A, B and C: Under these alternatives, Newlands Project efficiency would increase from an estimated 64.8 percent for existing conditions to an estimated 67.4 percent, based on the 95-year hydrologic simulation period (Table 4.3). Alternative C would be slightly more efficient than Alternative A, and Alternative B would be slightly less efficient than Alternative A. If, under Alternative C, water is delivered during winter (between mid-November and mid-March), Project efficiency could increase slightly higher, to an estimated 67.6 percent.

Alternative D: Under this alternative, Newlands Project efficiency would increase to an estimated 67.7 percent, a slightly higher calculated efficiency than the other alternatives, although this difference is likely immeasurable in the field. Most of this increase is associated with the winter-time deliveries that would occur under this alternative. If these deliveries are shifted to November, efficiency would be an estimated 67.5 percent.

4.2.2.4 Lahontan Reservoir Operations

Lahontan Reservoir operations parameters evaluated in this section include inflows, outflows, and storage. Lahontan Reservoir inflows consist of Carson River basin runoff and Truckee River imports via the Truckee Canal. Reservoir outflows consist of controlled releases to satisfy headgate demands, plus associated reservoir losses (evaporation and seepage), and, in some years, spills (in the form of accidental, precautionary, or operational releases not destined to meet headgate demands). Some of the water spilled during precautionary releases can be used to meet headgate demands by capturing the water in a down-gradient regulating reservoir for release later in the irrigation season.

Storage is the volume of water held in Lahontan Reservoir at any particular time. For the purposes of this Draft EIS, estimated storage volumes occurring on June 30 and November 30 are used to index the potential effects on Lahontan Reservoir storage. Lahontan reservoir storage targets, revised under the Adjusted OCAP (*Federal Register, Vol. 61, No. 237, 64815 - 64958*) (USDI 1997), prescribe when water may be diverted from the Truckee River to supplement Carson River inflow to Lahontan Reservoir. Storage targets are projected for the end of each month. January through June storage targets based on Carson River runoff forecasts for the months of April through July. The targets were intended to assist in the effective management of Truckee River water resources by minimizing unnecessary spills and moderating shortages while providing a supplemental water supply for irrigation in the Carson Division when necessary. Average June 30 storage volumes for each alternative represent the effects that each alternative has on storage during this period. The storage at the end of each irrigation season (represented by estimated average November 30 storage volumes) is considered carryover storage and is the foundation for the next year's storage.

Alternative A: Carson River inflow averages about 289,800 acre-feet/year based on the 95-year hydrologic simulation period (Table 4.4). This would not differ under any alternative. Truckee River imports (delivered) are estimated to decline from existing conditions to an average of about 37,700 acre-feet/year under the No Action Alternative (an estimated decline of 24 percent) following completion of the wetlands water-rights acquisition program. Calculated average total reservoir inflow amounts to about 327,500 acre-feet/year. Lahontan Reservoir releases to meet headgate demands would average about 246,700 acre-feet/year over the long term, based on the 95-year hydrologic simulation period. The long-term average June 30 Lahontan Reservoir storage volume, under the No Action Alternative, would be an estimated 218,380 acre-feet (1 percent higher than estimated existing conditions). Average November 30 storage volumes would be an estimated 112,400 acre-feet over the long term, which represents an increase over existing conditions of about 4 percent.. The effects of these changes from existing conditions are evaluated in the WRAP EIS, Section 4.2.5.

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Table 4.4. Potential effects of alternative water delivery schedules on Lahontan Reservoir operations, including inflow, outflow, and storage, based on Below Lahontan Reservoir Model results (numbers are expressed in long-term averages).

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
Inflow from:					
Carson River (AF)	289,800	289,800	289,800	289,800	289,800
Truckee Canal (AF)	49,810	37,700	38,200	37,270	36,470
Outflow					
Releases for Deliveries (AF)	261,100	246,700	246,600	246,800	246,600
Spills (AF)	42,800	44,600	45,400	44,300	43,000
Losses (AF)	34,920	35,400	35,200	35,220	35,870
Average Storage (AF) on:					
June 30	216,160	218,380	221,110	216,380	208,260
November 30	108,070	112,400	109,100	115,560	124,660

Source: Below Lahontan Reservoir Model results

Alternative B: Truckee Canal inflows under this alternative would decline from existing conditions by an estimated 23 percent, as compared to the 24 percent decline calculated for the No Action Alternative. Carson River flow would remain constant, which would result in an average total reservoir inflow of about 328,000 acre-feet/year (similar to baseline). The volume of water released from Lahontan Reservoir to meet headgate demands would, under Alternative B, be nearly identical to that occurring under Alternative A (a calculated 0.4 percent less) primarily because headgate demand would not change (all alternatives assume an identical headgate demand). A shift in the seasonal delivery pattern in the Carson Division during March-June (an overall reduction in demand during this period; Table 4.3) would result in long-term average June 30 storage volumes (Table 4.4) increasing beyond existing conditions by an estimated 2.3 percent, compared to the 1 percent increase estimated for Alternative A. The shift in the demand distribution during March-June could affect calculations used to project May or June storage targets under the Adjusted OCAP (USBOR 1997). In years when these calculations are necessary, this could be remedied by revising the C2 coefficients specified in the Adjusted OCAP. Long-term average November 30 storage volumes would increase by 1 percent as compared to the 4 percent increase calculated for Alternative A, due to the fall emphasis of the water-delivery schedule of this alternative.

Alternative C: Truckee Canal inflows would decline from existing conditions by an estimated 25 percent, as compared to the 24 percent decline under Alternative A. Carson River flow would remain constant, which would result in an average total reservoir inflow of about 327,070 acre-feet/year (nearly identical to Alternative A). The volume of water released from Lahontan

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Reservoir to meet headgate demands would also be nearly identical to that occurring under Alternative A, as explained under Alternative B. Although the shift in the seasonal delivery pattern for Stillwater NWR would increase demand earlier in the irrigation season (March), the overall March-June demand would not change markedly from existing and Alternative A (Table 4.3). This would result in a long-term average June 30 storage volume being nearly identical to that estimated for existing conditions, as compared to a slight increase under the No Action Alternative (an estimated 1 percent difference). The slight shift in Carson Division-wide demand distribution during March-June would likely not affect calculations used to project May or June storage targets under the Adjusted OCAP (USBOR 1997). Revisions could be made to the C2 coefficients specified in the Adjusted OCAP, if necessary. November 30 storage volumes would increase by 6.9 percent, as compared to the 4 percent increase calculated for Alternative A, due to the spring delivery emphasis of Alternative C's water-delivery schedule. According to the Below Lahontan Reservoir model, delivering water to Stillwater NWR during winter, as outlined in Chapter 3, would not change the average June 30 storage volume, but the average November 30 storage volume would be higher (an estimated 117,450 acre-feet).

Alternative D: Comparable to the 24 percent decline under Alternative A, Truckee Canal inflows would decline from existing conditions by an estimated 26.8 percent. Carson River flow would remain constant, which would result in a long-term average total reservoir inflow of about 326,270 acre-feet/year. Under Alternative D, the volume of water released from Lahontan Reservoir to meet headgate demands would be nearly identical to that of Alternative A. An increase in the early summer demand (Table 4.3) would result in the long-term average June 30 storage volume (Table 4.4) declining from existing conditions by an estimated 3.7 percent, as compared to a slight increase under the No Action Alternative. The shift in the demand distribution during March-June could contribute to errors in meeting May or June storage targets under the Adjusted OCAP (USBOR 1997) by overestimating the end of month storage volumes for May and June. This could be remedied by revising the C2 coefficients specified in the Adjusted OCAP. November storage volumes would increase by 15.4 percent, as compared to the 4 percent increase calculated for Alternative A. Water deliveries would occur later in the season than under Alternative C, but Alternative D would result in much greater volumes of water being delivered prior to late summer and fall, thus contributing to higher fall storage in Lahontan Reservoir.

4.2.2.5 Hydropower Resources

Hydropower generation associated with the Newlands Project facilities is a function of Lahontan Reservoir releases, which are determined by irrigation demand. Money received from hydropower generation is used to offset Newlands Project Operation and Maintenance costs. Therefore, reductions in hydropower revenues would adversely impact the project operator. If such losses occurred, the Newlands Project operator could potentially increase project water user operations and maintenance fees to make up the shortfall. A portion of this increased cost would be passed on to the Service and the State of Nevada as Newlands Project water users.

Two power plants located at Lahontan Dam, with capacities of 1.92 and 4.8 megawatts can receive water from the Truckee Canal or Lahontan Reservoir. Controlled releases at Lahontan Dam are made preferentially through the Old Lahontan Power Plant, a 1.9 megawatt power plant leased to Sierra Pacific Power Company. Releases are made secondarily through the New Lahontan Power Plant, a 4.8 megawatt facility completed in 1989 by Truckee-Carson Irrigation District and Lahontan Hydropower, Inc. TCID receives monthly payments from Sierra Pacific Power Company for electricity sold withing TCID's franchise area. These payments are not tied to the amount of power generated by the Old Lahontan Plant. A third, small power plant on the V-Line Canal at the 26-Foot-Drop structure also generates power.

The power plants do not have specific water rights, so irrigation demands — not hydropower needs — dictate when releases are made. Revenues associated with the Old Lahontan and V-Line Canal Power Plants are not tied to power generation and therefore are not affected by varying the reservoir releases. The revenues associated with long-term annual power generation at the New Lahontan Power Plant vary with hydrologic flow.

Alternative A: Under Alternative A, the No Action Alternative, the average amount of energy generated at the Old Lahontan, New Lahontan, and 26-Foot-Drop (V-Line Canal) Power Plants would decline from existing conditions by an estimated 8.6 percent to about 19,800 megawatt hours/year (Table 4.5). Hydropower revenues associated with the Old Lahontan and 26-Foot-Drop Power Plants are based on fixed rates and do not vary with Newlands Project releases. These revenues would remain unchanged under the No Action Alternative and other alternatives. The revenues associated with the New Lahontan Power Plant correlate to reservoir releases and would decline from existing conditions by an estimated 8.9 percent to about $797,300/year on average (Table 4.5).

Table 4.5. Potential effects of alternative water delivery schedules on Newlands Project hydropower generation and revenues, based on Below Lahontan Reservoir Model results.

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
Old Hydro. Plant (GWh)	7,900	7,800	8,100	8,760	7,410
26-Foot-Drop (GWh)	2,340	1,600	1,600	1,550	1,540
New Hydro. Plant (GWh)	11,420	10,400	10,100	8,970	10,210
Total (Gwh)	21,660	19,800	19,800	19,280	19,160
New Hydro. Revenues ($)	875,010	797,300	774,800	684,760	768,240

Source: Below Lahontan Reservoir Model results

Alternative B: Energy generation at the Old Lahontan, New Lahontan, and V-Line Canal power plants, combined, would decline from existing conditions by an estimated 8.6 percent, which is the same as would occur under the No Action Alternative. However, because of timing differences, revenues would decline from existing conditions by an estimated 11 percent, which is a bigger reduction than would occur under Alternative A. In the long term, Alternatives A and B would difference by about $22,490/year.

Alternatives C and D: The combined energy generation under Alternatives C and D would decline from existing conditions by an estimated 11 and 11.5 percent, respectively, as compared

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to the 8.6 percent decline estimated for Alternatives A and B. Due to reduced annual energy generation combined with differences in timing of releases, revenues would declines from estimated existing conditions by an estimated 22 percent under Alternative C and 12.2 percent under Alternative D. Revenues would decline more under Alternative C than under Alternative A because more water would be passed through the Old Lahontan Power Plant (reducing water volume through the New Lahontan Power Plant) due to the delivery pattern being more spread-out across the irrigation season, and more water would be released from Lahontan Reservoir during lower reservoir levels (less power being generated by the water that does pass through the New Lahontan Power Plant). Conversely, power generation at the Old Lahontan Power Plant under Alternative D would be less than under Alternative A because higher volumes of water would be released within a shorter period of time. In the long term, Alternatives A and C would differ by an estimated $113,140/year and Alternatives A and D would differ by an estimated $29,060/year. This only represents the difference in revenues paid to TCID from Sierra Pacific Power, and does not account for 12 percent increase in power generation at the Old Power Plant (Alternative C as compared to Alternative A). Winter deliveries for Alternative C would not change the estimates measurably (less than 2 percent).

Mitigation Measures

There are a number of mitigation measures that could minimize, or compensate for, the estimated losses in energy generation and associated revenue. Several mitigation measures are described in the WRAP EIS (USFWS 1996a), pages 4-20 and 4-21.

Switching generation priorities at the Old and New Lahontan Power Plants has the potential to increase power generation and the revenues generated from power generation at the New Power Plant. This action would entail making Lahontan Reservoir releases through the New Lahontan Plant (a 4.8 megawatt facility) first and then the Old Lahontan Plant (a 1.9 megawatt facility) secondarily. Such a change in priority would require changes in licensing by the Federal Energy Commission for the two power plants, as well as the agreement between TCID and the Sierra Pacific Power Company.

4.2.2.6 Newlands Project Canal Capacities and their Operation

The infrastructure of the Carson Division of the Newlands Project was designed to store water in Lahontan Reservoir and delivery this water to water-righted farmland in the Lahontan Valley. Because there are progressively fewer headgates with greater distances from Lahontan Reservoir, the capacity of delivery canals was largest at the top of the project (nearest Lahontan Reservoir) and smallest at the peripheries of the project. At the time of construction in the early 1900s, there was no perceived need to maintain the large capacities of delivery canals to the ends of the project. However, with the enactment of Public Law 101-618, wildlife conservation is now a designated purpose for which the Newlands Project is to be operated and maintained and Lahontan Valley wetlands, located at the peripheries of the Project, are now a major water user. The ongoing water-rights acquisition program (USFWS 1996a) could result in potential delivery conflicts because larger volumes of water must now be delivered to the peripheries of the project. Changes to the seasonal pattern of wetland deliveries to better achieve the purposes of Stillwater NWR and wildlife conservation in general, has the potential to contribute further to delivery

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conflicts resulting from canal capacity limitations if canal capacities leading to wetland areas are not enlarged to meet the expanded purposes of the Newlands Project.

Potential problems with canal capacity are already surfacing with only the existing volume of water rights being delivered to Stillwater NWR. As additional water rights are acquired and transferred to Stillwater NWR under the water-rights acquisition program, additional problems are anticipated.

Alternative A: Under Alternative A, which would assume the seasonal delivery pattern identified in the WRAP EIS (USFWS 1996a), up to as much as 200 cfs would have to be delivered to Stillwater NWR at times to meet the headgate demand of this alternative. This peak in demand corresponds to the peak in demand for the Carson Division as a whole, as it was patterned after this seasonal pattern. To meet headgate demands of other, upstream users, canal capacity leading to the refuge would have to be well in excess of 200 cubic-feet/second to allow concurrent delivery to other users. At present canal capacity leading onto the refuge is 450 cfs.

Although the acquisition of additional water rights for Stillwater NWR under the Service's water-rights acquisition program (USFWS 1996a) will contribute further to canal capacity conflicts near the refuge, most of the water rights being acquired are from this end of the Carson Division, which would tend to diminish conflicts. However, for the water users that remain near Stillwater NWR and farmers within the approved boundary of Stillwater NWR, there could be increasing competition for canal space under the No Action Alternative.

Alternative B: Effects of this alternative would be similar to Alternative A, except that peak demand would not be as high and it would occur shortly after the peak in demand for the rest of the Carson Division.

Alternatives C and D: Under Alternative C, the Service would call for more water primarily during a period when few farmers are calling for water (e.g., late March and early April), which would tend to reduce conflicts with other water users as compared to the No Action Alternative. However, the volume of water to be delivered in a short period during the latter half of March would be substantial and the capacity of canals may be inadequate for this purpose, given other delivery demands. Needs could be as high as 450 cfs during peak wetland water demand under Alternative C because only two weeks are available for delivery during March, and wetland-habitat acreage must peak by April 1 to minimize nest flooding. In the absence of enlargements of the canals to accommodate larger delivery volumes during March under this alternative, the delivery period of a portion of this block of water would have to be done in April. Without modifications to canals leading to the refuge, limited inflow of spill-water into Stillwater NWR would continue to hamper achievement of refuge purposes and goals under this alternative.

Under Alternative D, impacts would be similar to those of Alternative C, except there could be more effects on other water users because the peak delivery months would be May and June, as compared to March and early April. An estimated peak inflow of 350 cfs for operational deliveries would be anticipated for Alternative D, compared to the peak of 250 cfs under Alternative A. Although Alternative D could result in an increased peak demand (in terms of inflow rate into Stillwater NWR) of up to 40 percent beyond that of Alternative A, this peak demand would occur during a month when overall demand in the Carson Division is about 20 percent lower than when the peak deliveries would occur under Alternative A.

To the extent that water is delivered to Stillwater NWR during the winter under either alternative, the potential for damage due to freezing would increase. The Newlands Project contractor (TCID) performs various maintenance and repair activities on Newlands Project facilities during mid-November through mid-March, is the non-irrigation season for farmland in the Lahontan Valley. Many of these activities require the draining of water from water-conveyance facilities (e.g., canals) and facilities being maintained or repaired during this time may not be available for deliveries. Furthermore, "Winter operation of a canal system where temperatures are subfreezing may require additional canal and structure freeboard to permit wintertime design capacity to flow under an ice cover. At subfreezing temperatures, an ice cover readily forms when velocities are less than 2.2 feet per second. If velocities are fast enough to prevent formation of ice cover, frazil ice may form, and if allowed to accumulate on racks at inlets to structures will cause backwater. Additional forces caused by expansion of the ice cover or by ice lenses in clayey foundation materials should be considered" (Aisenbrey et al. 1987). Before Sheckler Reservoir is used for winter deliveries, it would likely need a core and its outlet would likely need to be modified (e.g., heated).

Winter operations could increase costs to TCID, primarily in terms of personnel costs. During the nonirrigation season, ditch riders are on accrued annual vacation for up to two months. When ditch riders are not on vacation during the nonirrigation season, they are involved in maintenance activities such as burning and cleaning ditches. Additional staff time would be required to deliver water outside the traditional irrigation season of mid-November through mid-March.

Mitigation Measures: It is possible that Alternative C, as outlined in Chapter 3, would contribute further to canal capacity limitations, beyond those that will occur under the No Action Alternative. These canal restrictions could be resolved in several ways. Canals could be enlarged to accommodate higher flow volumes beyond the enlargements required by Alternative A, which would also allow for larger volumes of spill-water to be conveyed to the refuge. Allowing the irrigation season to begin on March 1 or March 7, rather than on March 15 would increase the amount of time to deliver Alternative C's March water demand, which would reduce the needed canal capacity (for operational deliveries) below that needed under the No Action Alternative. Large-volume deliveries to the refuge in March could be accommodate with lower canal capacities than could lesser deliveries during peak irrigation months. Another possibility would be to extend the delivery period of the March water into April, which could result in higher nest flooding. To reduce the impacts of nest flooding, the peak acreage targeted for April 1 could be reduced somewhat, and the water not delivered during March could be delivered in April and even into May to maintain a more stable wetland-habitat acreage during the nesting season. Some of these options could also resolve canal capacity limitation and delivery conflicts under Alternative D, but not all would apply because the peak delivery period (May) occurs in a high use period for other irrigators.

The U.S. Army Corps of Engineers is currently studying the feasibility of modifying existing infrastructure to reduce flood potential in this area. If this effort was coordinated with the enlargement of canals to meet the increasing headgate demands of Stillwater NWR (under the ongoing water-rights acquisition program), the two projects could complement each other. Enlargement of Newlands Project canal to convey larger volumes of water to Stillwater NWR during precautionary releases and spills from Lahontan Reservoir could augment efforts to reduce flood potential in the Fallon area and, depending on design, could accommodate the larger volumes of water to be delivered to Stillwater NWR in the future and thereby reduce delivery conflicts with other water users.

To minimize operational and facility impacts of delivering water during the winter, refuge deliveries, including delivery route, and maintenance work performed by TCID on canals could be coordinated. Water needed to meet winter demands could be stored in regulating reservoirs below Lahontan Reservoir. To minimize damage caused by freezing, water conveyance facilities could be modified or delivery rates and delivery points could be coordinated with TCID.

4.2.2.7 Derby Dam and Truckee Canal

In this section, the potential effects of the alternatives on the diversion of Truckee River water into the Truckee Canal at Derby Dam are discussed. Irrigation deliveries to the Truckee Division would remain unchanged across the action alternatives.

Alternative A: Under Alternative A, the long-term average volume of Truckee River diversions at Derby Dam would decline from estimated existing conditions by about 15.7 percent to a long-term average of about 74,400 acre-feet/year (Table 4.6).

Table 4.6. Potential effects of alternative water delivery schedules on the Truckee Canal (Derby Diversions), lower Truckee River (Derby Releases), and Pyramid Lake inflow and elevation, based on Below Lahontan Reservoir Model results.

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
Derby Diversions (AF)	88,250	74,410	74,950	73,900	73,120
Derby Release (AF)	475,660	489,130	488,550	489,650	490,620
Pyramid Lake Inflow (AF)	483,330	496,700	496,140	497,210	498,140
Pyramid Lake Elev. (ft)	3,836.88	3,840.01	3,839.52	3,840.12	3,840.44

Source: Below Lahontan Reservoir Model results, U.S. Bureau of Reclamation.

Alternative B: Under this alternative, the average volume of water to be diverted into the Truckee Canal at the Derby Dam would decline from existing conditions by an estimated 15.0 percent, which is a slightly lesser decline than would occur under Alternative A. The water delivery schedule under this alternative is somewhat flexible. Delivering higher volumes of water toward the latter part of the summer and fall would contribute to fewer reductions in Derby diversions than shown in Table 4.6, while delivering higher volumes of water in the spring and early summer would result in greater reductions in Derby diversions.

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Alternative C: The average volume of water to be diverted into the Truckee Canal at the Derby Dam under Alternative C would decline from existing conditions by an estimated 16.3 percent, a slightly larger decline than would occur under Alternative A. The water delivery schedule under this alternative is somewhat flexible. Delivering higher volumes of water toward the latter part of the summer and fall would contribute to fewer reductions in Derby diversions than shown in Table 4.6, while delivering higher volumes of water in the spring and early summer would result in greater reductions in Derby diversions.

Alternative D: Under this alternative, the average volume of water to be diverted into the Truckee Canal at the Derby Dam would decline from existing conditions by an estimated 19.9 percent, which is a larger decline than would occur under Alternative A. This further decline in Derby diversions is attributed to winter deliveries and proportionately less water being delivered near the latter end of the irrigation season. Greater volumes of water delivered in the early spring and fewer deliveries in the late summer and fall would result in higher Lahontan Reservoir storage levels in the fall (e.g., November 30 levels, Table 4.4) and greater carryover to the following irrigation season.

4.2.3 Lower Truckee River and Pyramid Lake

This section covers the potential effects of the alternatives on hydrology of the lower Truckee River and Pyramid Lake. Mitigation measures were not identified in the following sections because the action alternatives would have no significant impacts on the Lower Truckee River or Pyramid Lake.

Alternative A: Under this alternative, the long-term average volume of Truckee River diversions at Derby Dam identified above would leave approximately 489,100 acre-feet/year to be released from Derby Dam down the lower Truckee River (Table 4.6), which is 2.8 percent more than is estimated to occur under existing conditions. The water-surface elevation of Pyramid Lake would be an estimated 3,840 feet under baseline conditions, compared to the long-term estimate of 3,836.9 feet under existing water-management assumptions (an increase of more than 3 feet). The lake elevation was 3,809 feet in July 1997 and it would take an estimated 60 to 70 years to attain an elevation of 3,840 feet (USBOR 1997), assuming a long-term average of 480,500 acre-feet of inflow.

Alternative B: Under this alternative, lower Truckee River flows would be similar to flows that would occur under Alternative A (slightly less flows than estimated for Alternative A). Effects to the eventual water-surface elevation of Pyramid Lake would be negligible (the lake elevation would eventually be an estimated 2.6 feet higher than would occur under existing management assumptions, as compared to an increase of 3.1 feet under Alternative A).

Alternative C: The estimated increased flow volumes in the lower Truckee River that could occur under Alternative C would be negligible, but they would not conflict with the objectives of the 1988 OCAP (slightly higher flows than estimated for Alternative A). Similarly, there would be no measurable impacts to the eventual elevation of Pyramid Lake (an estimated 1/10-foot difference between Alternatives A and C).

Alternative D: Under this alternative, the average volume of water to be diverted into the Truckee Canal at the Derby Dam could result in an estimated 3.1 percent increase, from existing conditions, in lower Truckee River flows (compared to the 1.2 percent increase under Alternative A). Based on the Below Lahontan Reservoir Model, the surface of Pyramid Lake could potentially increase from the eventual level under existing management assumptions (3,836.88 feet) to 3,840.44 feet, a 3.6 foot increase (compared to the 3.1 feet under Alternative A). Because Pyramid Lake would begin flooding highways above a water-surface elevation of 3,840 feet (USDI 1997), this alternative could potentially contribute toward flooding some highways near Pyramid Lake in the long term.

4.2.4 Air Quality

The air quality of a given area is determined by the amount of pollutants released into the atmosphere and the atmosphere's ability to transport and dilute the pollutants. The Federal Clean Air Act, as amended in 1970, 1977, and 1990, established air quality standards and the authority of the EPA to enforce the standards. In Nevada, the State has the authority to implement the air quality program with the Nevada Revised Statues (445.401 to 445.601). The Nevada standards are equal to, or more stringent than, the Federal National Ambient Air Quality Standards set by the EPA. The pollutants addressed by Federal and State air quality standards are: nitrogen dioxide, total suspended particulates, inhalable particles (PM_{10}), sulfur dioxide, ozone, carbon monoxide, lead, and hydrogen sulfide. Dust, soot, ash, and chemicals given off by burning are key factors affecting inhalable particulates (PM_{10}), which is the only element that State air quality officials have identified as a potential pollutant of concern in the affected area.

Air quality in the study area is good overall, and is "in attainment" for all monitored air quality pollutants. Some concern has been expressed about the concentration of inhalable particulates (PM_{10}) in the region, although data recorded at a sampling station in Fallon from 1993 to 1994 indicate PM_{10} levels in the region generally do not exceed Nevada air quality standards. Suspended particulates are derived from numerous sources but particulate emissions in Churchill County originate from desert lands that are naturally low in vegetative cover, and consequently are subject to wind erosion. For more detail on the air quality in the study area, readers are referred to the WRAP EIS.

Potential impacts of the water-rights acquisition program on inhalable particulates in Churchill County were addressed in the *Lahontan Valley Wetlands Water Rights Acquisition Program Final EIS* (WRAP EIS; USFWS 1996), and therefore are not addressed here. No additional farmland would be taken out of production as a consequence of actions being evaluated in this Draft EIS. The greatest potential for EPA standards to be exceeded would occur during wildfires, the potential of which would be similar between all alternatives. Regardless of the alternative selected, a fire management plan would be finalized within six months of the implementation of a comprehensive conservation plan for the Stillwater NWR Complex. The plan, which is now in draft form, will address prescribed burning as well as wildfire abatement.

As of the writing of this plan, the State of Nevada is in the process of developing a State Smoke Management Plan to address air quality issues. There are no nonattainment areas near Stillwater NWR. Smoke sensitive areas include roads on Stillwater NWR Complex, County, and State roads. The community of Fallon, Nevada (population 20,000) is approximately six miles southwest of Stillwater WMA and about 14 miles southwest of Stillwater NWR. The Naval Air Station-Fallon is approximately 15 miles south of the Stillwater NWR. Private and Tribal lands adjacent to the Refuge are primarily agricultural with some single family residences. Agricultural burning in and around Stillwater NWR is widespread, frequent, and commonly accepted by the public.

Alternative A: For the purposes of this analysis, it is assumed that prescribed burning would not be carried out under Alternative A. No prescribed burns have been completed during the last ten years on the Stillwater NWR, Fallon NWR, or Stillwater WMA. A fire management plan, primarily to address potential wildfires, would be developed under this alternative.

Table 4.7. Representative prescribed fire emissions.

Burn Type	Average Size of Burn	PM10 Emissions per Burn
wetland	75 acres	2.25 tons
restored native upland	30 acres	.45 tons
maintenance	20 acres	.1 tons

Source: Fire Management Team, Sheldon-Hart Mountain NWR Complex, Oregon.

Alternatives B and C: Under these alternatives, prescribed burning would occur an average of three to five days each year, although prescribed burning would not occur in many years. No significant impacts to air quality would be anticipated. Temporary air quality impacts from smoke may occur, but measures to reduce smoke emissions would be incorporated into prescriptions, including techniques that have a low rate of spread (allowing fires to burn longer, thus reducing the length of time nonburned fuel will smolder), burning when fuel moisture levels are sufficiently low.

Prescribed fire operations would be conducted in compliance with the Nevada State Smoke Management Plan. Individual prescribed burn plans would specifically address smoke management concerns and actions required to ensure public safety and prevent negative impacts from smoke. The public will be informed of prescribed fire activity on the refuge through several methods including; (1) in person or by telephone calls to refuge neighbors, (2) refuge press releases, (3) bulletins posted at information kiosks, (4) warning signs and other traffic control devices. Tribal, military, and county entities will be contacted, by phone or in person, prior to burning as part the required elements of each prescribed burn plan.

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Burn plans will also include contingency plans which will be implemented in the event of unexpected negative smoke conditions. In general, prescribed burns will be small (average 50 to 100 acres), have light fuel loads (0.25 to 3 tons of fuel per acre), will be burned under low fuel moisture conditions, and will be burned under specific wind direction and atmospheric stability conditions.

Prescribed burns on the refuge would fall into the Prescribed Fire Units: wetlands, restored native uplands, and maintenance. Table 4.7 illustrates representative PM_{10} emissions in tons per average burn.

Alternative D: No prescribed burning would occur under this alternative, and therefore adverse impacts due to prescribed burning would not occur.

Mitigation Measures

Mitigation measures to minimize or reduce smoke emissions during prescribed burning would be an integral part of the fire management plan (Appendix K).

4.3 PHYSICAL ENVIRONMENT — REFUGE LANDS AND WATERS

4.3.1 Acreage Base

4.3.1.1 Stillwater NWR, Stillwater WMA, and Fallon NWR

Alternative A: At present, Stillwater NWR is about 79,570 acres of Federal land, Stillwater WMA is about 65,603 acres, and Fallon NWR is about 17,848 acres, for a combined total of 163,021 acres of Federal land. Non-Federal inholdings within the existing boundaries make up about 59,708 acres (Table 4.8; Map 1.4).

Table 4.8. Approximate acreages of Federal and non-Federal lands[1] within alternative boundaries of Stillwater NWR and other Federal wildlife areas within the Lahontan Valley.

	Approximate Acreages			
	Alternative A (Existing)	Alternative B	Alternative C (Preferred)	Alternative D
Federal Lands				
Stillwater NWR	79,570	79,570	137,504	167,806
Stillwater WMA	65,603	0	0	0
Fallon NWR	17,848	17,848	0	0
Subtotal	163,021	97,418	137,504	167,806
Non-Federal Lands				
Private	41,224	9,249	22,661	42,881
County	12,717	0	8,242	15,277
State	5,767	1,287	3,847	5,767
Subtotal	59,708	10,536	34,750	63,925
TOTAL	222,729	107,954	172,254	231,731

[1] This table illustrates the extent to which Federal and non-Federal lands would fall within approved boundaries of Federally-managed wildlife areas in the Lahontan Valley under each alternative.

Alternatives B-D: Each alternative would retain differing amounts of Federal land within the Stillwater NWR Complex in the Lahontan Valley, with Alternative B retaining the least amount and Alternative D the most. Alternatives C and D would encompass the largest amount of Federal land in the long term, but much of the western and northwestern sides of Alternative D's boundary would likely continue to be checkerboarded well into the future. The change in status of Federal lands due to a boundary revision would have no marked impacts, although changes in management due to the shift in management authorities could potentially have impacts. Mitigation measures associated with these potential impacts are addressed in discussions of these resources.

4.3.1.2 Anaho Island NWR

Anaho Island NWR encompasses the entire island, the size of which is determined by the level of Pyramid Lake. In 1913 when the refuge was established, the island was 247 acres. When Pyramid Lake was at its lowest point in 1977, the potential for the formation of a land bridge between the island and the nearby shoreline became a concern. Cessation of winter hydroelectric generation, implementation of the 1988 OCAP, and high water years during the mid 1980s raised the lake level, which resulted in the island shrinking back to 575 acres by the summer of 1997 and to 490 acres by the summer of 1999.

Alternative A: Under this alternative, which assumes full implementation of the 1997 adjustments to OCAP, Anaho Island is expected to average 245 acres over the long term.

Alternatives B and C: The water level of Pyramid Lake is not expected to be affected measurably by these alternatives, as compared to Alternative A. Modeled results estimate a slightly lower water level under Alternative B in the long term (Table 4.6), which would result in slightly higher acreage than under Alternative A. Conversely, modeled results for Alternative C estimate a slightly higher water level, which would result in slightly less island acreage. Both alternatives would result in less than a 1 percent change in acreage.

Alternative D: Under this alternative, the water level of Pyramid Lake could be as much as 1 foot higher than under Alternative A in the long term. This would result in a slightly smaller island on average (less than 10 fewer acres) than under Alternatives A, B, and C. Even under this alternative, the size of the island would be larger than it was prior to the 1900s.

4.3.2 Topography and Soils

While there would be few, if any, changes to topography and soils, alterations could occur in localized areas. Topographic features and soils that could potentially be affected include the shape and location of Stillwater Slough and lower Carson River, berms that were built up to the side of canals (during canal cleaning operations), wetland units in which deeper canals could be constructed, and wetland soils that could change in composition due to altered water flow regimes. Over the long term, sand dunes will continue to move across the landscape, and without a sand source sand-dune dynamics may be affected.

Few alterations would occur under all alternatives. Under Alternatives C and D, efforts would be undertaken to lower or remove berms adjacent to on-refuge canals to restore a more natural appearance, otherwise enhance aesthetics, and to remove perches from which common ravens scan for waterbird nests. Consideration would also be given to recontouring Stillwater Slough and possibly parts of the lower Carson River, but before this is undertaken, potential effects on surrounding lands and water users would be evaluated.

The alternatives considered in this Draft EIS would have no measurable effects on wetland soils. Changes to wetland soils over time, if any, would result from larger volumes of fresh water entering the system as a consequence of the water-rights acquisition program. Although this is anticipated for all alternatives, it would only occur to the extent that salts from groundwater sources do not totally replace lost salts.

4.3.3 Refuge Wetlands

In general, wetlands are areas that are at least periodically saturated or covered with water. More than 300,000 acres of land in the Lahontan Valley have been classified as wetlands. Primary wetland areas are those wetland areas specified in Public Law 101-618. The four areas identified were Stillwater NWR, Stillwater WMA, Carson Lake, and wetlands on the Fallon Paiute-Shoshone Indian Reservation. Other wetlands in Lahontan Valley are referred to as secondary wetlands. Although background information is provided below on all Lahontan Valley wetlands, this section focuses on the wetlands of the Stillwater NWR Complex.

Archaeological evidence and pollen cores indicate that a relatively permanent marsh has existed in the Stillwater area for at least 4,000 years. Prior to Euro-American settlement, there was an estimated average of 150,000 acres of wetland-habitat in the Lahontan Valley (Kerley et al. 1993). The Carson River and its riparian corridor, Carson Lake, Stillwater Marsh, and Carson Sink are remnants of the historic Lahontan Valley wetlands.

When they have water, the Lahontan Valley wetlands are some of the most productive in the western United States. They are unique in that they provide expansive areas of shallow wetland-habitats with waters of varying salinity. The Lahontan Valley wetlands are characterized by shrinking and swelling, both seasonally and annually, as well as over geologic time. This fluctuation creates a diverse Great Basin wetland ecosystem, which encompasses a wide range of wetland-habitat types within a localized area. Within the span of one season, these wetlands can be transformed from shallow lakes with clear, freshwater, to shallow, brackish marshes with high salt concentrations.

Historically, runoff from the Sierra Nevadas (via the Carson River) constituted the primary inflow to the Lahontan Valley wetlands. Runoff from April through June accounted for about 40 to 60 percent of the total annual flow. In most years, the maximum spring flow volumes flushed the initial wetland-habitat of accumulated salts and other dissolved solids. On average, roughly 15-20 acre-feet/year of water flowed into Stillwater Marsh for every acre of wetland-habitat (based on information in Kerley et al. 1993), meaning that about 10-15 acre-feet/acre/year of water flowed through the marsh into the Carson Sink. During the summer, as Carson River inflow decreased and the evaporation rate increased, the wetlands shrank, leaving shallower, more saline marsh habitats. These seasonal fluctuations created a variety of riparian and wetland-habitats, including braided river channels, closed oxbows, perennial and ephemeral marshes and wetted playas in Lahontan Valley's terminal wetlands. This diversity of habitats attracted a wide range of animal species, including vast populations of ducks, geese, pelicans, wading birds and shorebirds.

The Newlands Project and other upstream diversions have completely altered the natural hydrologic regime in the Lahontan Valley wetlands. Upstream diversions required for agriculture have steadily dried Stillwater Marsh, Carson Lake, and Carson Sink in all but the wettest years. From the early 1900s to the late 1960s, the Lahontan Valley wetlands have subsisted on seepage losses and drainflows from the Newlands Project irrigation system, water from winter power generation (primarily Truckee River water), and periodic spills in high water years.

Episodic flooding, which once sent voluminous spring flows into the marshes, was contained by Lahontan Dam and stored in Lahontan Reservoir for irrigation use. Newlands Project drainwater inflows allowed the wetlands to survive, but water chemistry was altered compared to Carson River inflows, with increased dissolved solids and contaminants from agricultural use. Most of the water that did reach the wetlands arrived gradually, over a six- to seven-month period in the summer. These flow volumes have generally been too low to flush accumulated salts and contaminants from the wetlands.

By 1948, with the number of migratory birds in the marshes decreasing, the Service, Nevada Fish and Game Commission (now the Nevada Department of Wildlife), and TCID entered into an agreement to manage the marshes. A series of dikes, canals, and water control structures were built in Stillwater Marsh to better manage the shrinking supply of water making it to the wetlands. With significantly lower volumes of water reaching the wetlands, dikes and water-control structures have allowed managers more control over water for producing wetland-habitat of benefit to wetland wildlife. The significantly reduced water volumes and increased concentrations of dissolved solids and toxic elements have substantially reduced the number of freshwater vegetative communities.

Flow patterns to the wetlands were again altered in the late 1960s when the Secretary implemented the Newlands Project operating criteria and procedures. This action eliminated diversions for winter power generation and limited Lahontan Reservoir releases for irrigation. Without releases for winter power generation, large volumes of quality water that had previously flushed and sustained the wetlands during the winter months were no longer available. Due to the decreased flow, the wetland manager's options for flushing salt accumulations were reduced, leading to fewer, less effective spring flushes. As a result, the marshes became saline. Marsh vegetation shifted to those species which could tolerate higher concentrations of dissolved salts, and many stands of hardstem bulrush were lost.

Between 1972 and 1975, an average of about 40,300 acres of wetland-habitat (primary and secondary) remained in the Lahontan Valley. Since then, the Department of the Interior has implemented more efficient operating criteria and procedures and there have been floods, and a drought. As a result, wetland acreage has fluctuated widely. By 1992, the effects of a six-year drought had caused wetland acreage to drop to a record low of about 2,400 acres valley-wide. Following three consecutive years (1995-1997) of above average runoff, the amount of primary wetland-habitat (Stillwater NWR, Carson Lake and Pasture, and Tribal wetlands) had increased to approximately 24,100 acres as of August 1997.

Because the water-rights acquisition program is new and ongoing, thus no long-term data is available on trends, and given the highly variable nature of hydrology in the Great Basin, existing and baseline wetland-habitat conditions are modeled. Effects that alternative water-delivery schedules could have on seasonal and annual wetland-habitat acreage were estimated using a spreadsheet model described in Appendix I.

Except where noted, no mitigation measures, with respect to the hydrology of refuge wetlands, would be necessary for the action alternatives because no significant adverse impacts would be anticipated. To the extent that biological, recreational, and socioeconomic resources would be adversely impacted by changes in seasonal wetland-habitat acreages, they are addressed in the appropriate sections. As pointed out in the 1996 Record of Decision for the WRAP EIS, future monitoring could find that a different volume of water is needed than has been anticipated. Should any significant change be proposed as a result of future monitoring, there will be a public review process and additional NEPA documentation will be completed if necessary.

4.3.3.1 Wetland-habitat Acreage

This section presents estimates of the potential effects that alternative water-delivery schedules would have on several wetland-habitat parameters, including (1) long-term average wetland-habitat acreage on Stillwater NWR; (2) seasonal pattern of wetland-habitat acreage, and (3) water chemistry in the wetlands.

Section 206 of Public Law 101-618 directs the Secretary of the Interior, in conjunction with the State of Nevada and other entities, to acquire sufficient water and water rights to sustain a long-term average of 25,000 acres of primary wetland-habitat in Lahontan Valley. An EIS and Record of Decision, completed in 1996, evaluated the impacts of acquiring 125,000 acre-feet of water, including 20,000 acre-feet of water rights addressed in an earlier environmental assessment, to sustain the targeted amount of primary wetland-habitat (USFWS 1996). Based on assumptions described in the WRAP EIS, sufficient water rights have been acquired thus far to sustain a long-term average of about 10,000 acres of primary wetland-habitat in the Lahontan Valley.

Each of the alternative water-delivery schedules would result in a different long-term average wetland-habitat acreage given a long-term average of 70,000 acre-feet/year of available water. Thus, each alternative would influence differently the Service's ability to maintain a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR.

In this Draft EIS, nonspill years and spill years are treated separately because of the vastly different wetland-habitat conditions they can produce, and because wetland-habitat conditions during nonspill years are heavily influenced by refuge management decisions where wetland-habitat conditions during spill years are dominated by factors beyond the wetland manager's control. Spills occur infrequently and unpredictably. Depending on timing and volume, the effects of a spill can mask the effects of water reaching Stillwater NWR from other sources. Therefore, most of the discussion addresses the effects of water-delivery schedules during nonspill years, with information on spill years provided as supplemental information. Given the volume of water rights that have been acquired thus far for Stillwater NWR, an estimated long-term average of 6,600 acres of wetland-habitat could be sustained during nonspill years. The transfer of some of these water rights has been contested and, therefore, this acreage will not be achieved for several years until transfer issues have been resolved.

In addition to fluctuations in wetland-habitat acreage between spill and nonspill years, wetland-habitat acreage will continue to vary from nonspill year to nonspill year due to a variety of factors, including carry-over storage in Lahontan Reservoir and snowpack in the Sierra Nevadas. To some extent, reductions in deliveries of water rights acquired in fee title, due to drought, could be offset by leasing additional water rights. Whether leasing will realistically provide such an option has yet to be determined.

The following evaluation of alternatives is included to give an indication of the Service's ability to achieve the 14,000-acre target for Stillwater NWR given a long-term average annual supply of 70,000 acre-feet. Several assumptions were made in this assessment. A long-term average of 13,500 acres of wetland-habitat would be maintained in Stillwater Marsh, assuming a long-term average of 500 acres of wetland-habitat in the Battleground Point area and along the Carson River and Stillwater Slough (these wetland areas are currently encompassed within the wetland areas identified in Public Law 101-618). Recognizing differences in nonspill and spill years, including no leasing during spill years, an estimated long-term average of 12,500 acres of wetland-habitat would have to be maintained in Stillwater Marsh during nonspill years to supplement a long-term average of 16,500 acres of wetland-habitat during spill years. The targeted 12,500 acres during nonspill years, which would occur under all alternatives at the completion of the water-rights acquisition program, represents a near doubling of wetland-habitat acreage compared to existing conditions (an estimated 6,600 acres).

Estimates for spill years and long-term averages assume that a considerable volume of spill-water will continue to reach Stillwater NWR and Fallon NWR, which would occur to the extent that excess water is conveyed to Stillwater NWR and Fallon NWR according to the 1997 Emergency Release Criteria for Lahontan Reservoir (USBOR 1997). If these criteria are not followed, additional water from other sources may be needed.

Following this section, all remaining assessments will assume a long-term average of 12,500 and 16,500 acres of wetland-habitat in Stillwater Marsh during nonspill and spill years, respectively, and a long-term average of 500 acres of wetland-habitat in Battleground Point area and along the lower Carson River and Stillwater Slough. An assumption of this Draft EIS is that a long-term average of about 14,000 acres will be maintained in Stillwater NWR. The estimates in this section represent our best understanding of conditions, given the available data, and are estimates of what could happen. The estimates are presented for the purposes of assessing gross differences between the alternatives. Modeling was conducted to aid the decision-maker and the public in understanding gross differences between the alternatives being considered. Output of the spreadsheet model used to estimate differences among alternatives cannot be used in determining whether changes are needed to the water-rights acquisition program because it was not designed for this purpose. Potential future changes to the water-rights acquisition program will be based on long-term monitoring data, which will be used to refine the estimated volume of water needed to maintain the targeted acreage (USFWS 1996b).

Because the timing of wetlands monitoring can affect the results of the monitoring program, especially given some of the alternative water-delivery schedules being considered, it is reevaluated in this Draft EIS. August was adopted in 1996 as the time for a once-per-year survey to monitor long-term wetland-habitat acreage (USFWS 1996b). Only nonspill years were included in the assessment because the timing and volume of spills are highly variable and irregular (therefore Table 4.10 only addresses the average of 12,500 acres of wetland-habitat to be maintained during nonspill years).

The alternatives explored in this Draft EIS would have no effects on primary wetland-habitat on Carson Lake or the Fallon Paiute-Shoshone Reservation, nor would they have any effects on secondary wetlands. Therefore, the assessment of potential effects on wetland-habitat is limited to the wetlands that currently exist within the boundaries of Stillwater NWR, Stillwater WMA, and Fallon Refuge.

All Alternatives: Under all alternatives, average wetland-habitat acreage would increase from an average of 6,600 acres during nonspill years (estimated existing conditions) to an estimated average of 12,500 acres (90 percent increase). Combined with spill years, a long-term average of 14,000 acres of wetland-habitat would be sustained (USFWS 1996a,b).

The following discussion explains how the delivery schedules of each alternative may affect the ability to sustain 12,500 acres of wetland-habitat during nonspill years given a long-term supply of 65,750 acre-feet/year of water during nonspill years. Where differences are identified between the nonspill target of 12,500 acres and the estimated acreage that a given alternative would produce, the differences are noted, and the potential effects on the water-rights acquisition program are identified in Section 4.3.3.2. However, increasing or decreasing the volume of water presented in the WRAP EIS and ROD is not considered in this Draft EIS because actual changes to the water-rights acquisition program will be based on long-term average measurements of wetland-habitat acreage and associated water volumes (USFWS 1996b). The figures presented below are estimates based on modeling.

Alternative A: Given a long-term average of 65,750 acre-feet/year of water during nonspill years, an estimated long-term average of 12,800 acres of wetland-habitat could be maintained during these years under this alternative's water-delivery schedule (Table 4.9), which is 300 acres more than the targeted 12,500 acres. Under this alternative, the timing of wetland monitoring would not be critical (Table 4.10), even when only one survey per year in August (USFWS 1996), due to the relatively nonfluctuating seasonal acreages.

Table 4.9. Potential effects of alternative water-delivery schedules on long-term average annual and seasonal wetland-habitat acreages in Stillwater Marsh during nonspill years, assuming a target of an average of 12,500 acres of wetland-habitat in nonspill years (and 16,500 acres in spill years to result in 13,500 acres/year on average).

		Existing	(No Action) Alternative A	Alternative B	Alternative C	Alternative D
Annual average		6,600	12,800	14,100	12,700	10,100
Annual average (corrected)		n/a	12,500	12,500	12,500	12,500
Seasonal acreages:						
Jan-Mar	Ave.	7,000	12,300	13,900	12,100	8,600
	(Range)	(7,200-6,900)	(12,700-12,000)	(14,200-13,700)	(10,900-14,800)	(7,300-10,200)
Apr-Jun	Ave.	6,700	12,500	13,200	17,000	19,600
	(Range)	(6,900-6,800)	(12,000-13,100)	(13,500-11,100)	(18,400-15,800)	(13,000-26,300)
	Peak Month	*April*	*June*	*April*	*April*	*June*
Jul-Sep	Ave.	6,000	12,400	10,100	10,300	15,900
	(Range)	(6,300-5,800)	(12,800-12,100)	(9,500-11,200)	(13,300-8,400)	(21,100-10,400)
Oct-Dec	Ave.	6,800	12,700	13,700	10,500	5,800
	(Range)	(6,300-7,200)	(12,300-13,100)	(12,400-14,600)	(10,000-10,900)	(6,400-5,200)

Table 4.10. Alternative ways to monitor long-term average wetland-habitat acreage on Stillwater NWR wetlands. Figures represent the long-term average wetland-habitat acreage during nonspill years that would result from each of several alternative monitoring programs, based on results of a seasonal wetland-habitat model. Spill years were not included due to their high variability.

	(No Action) Alternative A	Alternative B	Alternative C	Alternative D
August[A]	12,400	9,700	9,200	16,300
Monthly	12,500	12,500	12,500	12,500
Quarterly beginning in January[B]	12,450	12,400	13,150	11,950

[A] The approach adopted in the Final EIS and Record of Decision for the Water Rights Acquisition for Lahontan Valley Wetlands (USFWS 1996), which would continue the ongoing August surveys.

[B] Quarterly measurements beginning in January and continuing in April, July, and October

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Alternative B: Under this alternative's water-delivery schedule, an estimated 14,100 acres of wetland-habitat could be maintained during nonspill years with a supply of 65,750 acre-feet/year, which is 1,600 acres more than the targeted 12,500 acres. August monitoring would underestimate the average acreage of wetland-habitat that could be produced under this alternative (Table 4.10) because August falls at the lowest acreage period for this alternative. Substantially more water would be needed to elevate the August acreage while maintaining this alternative's water-delivery schedule. Quarterly or monthly monitoring would alleviate this problem, although costs of monthly monitoring may be prohibitive. No provisions would be made under this alternative to increase the water supply to Fallon NWR and, therefore, it would continue to only provide breeding habitat during spill years.

Alternative C: The long-term average acreage of wetland-habitat that would be maintained under this alternative during nonspill years, an estimated 12,700 acres, is similar to the targeted amount of 12,500 acres. The additional volume of spill-water that would be accommodated if the capacity of canals leading to the refuge is increased could result in higher wetland-habitat acreage during spill-years, which could result in less wetland-habitat being sustained in nonspill years. In some spill years, a portion of the spill-water entering Stillwater Marsh would pass through the marsh into Carson Sink without adding further to wetland-habitat acreage , but in other years it would increase wetland-habitat acreage. In the long-term, additional water acquired for the lower Carson River would also benefit the wetlands at its terminus (Battleground Point area), thereby increasing, to a small extent, the long-term average wetland-habitat in the area now encompassed within Fallon NWR. This would be an improvement over Alternative A for these wetlands, but could slightly reduce the wetland-habitat acreage in Stillwater Marsh because a lower acreage would have to be maintained in Stillwater Marsh to attain the 14,000-acre target of the refuge.

As under Alternative B, August monitoring of wetland-habitat would appear to result in the need for more water under Alternative C to achieve the 12,500-acre foot target for nonspill years. If an August wetland survey continues to be the sole survey used to calculate wetland-habitat acreage, more water would be needed to elevate the August acreage (Table 4.10). Monthly monitoring could alleviate this problem, and quarterly monitoring beginning in January may indicate that less water would be needed to sustain the targeted acreage. Quarterly monitoring would slightly overestimate the actual average acreage, and if used, could result in a slightly smaller amount of wetland-habitat being sustained over the long term as compared to the acreage that would be sustained under a monthly monitoring scenario.

Alternative D: Under this alternative, an estimated 10,100 acre-feet of wetland-habitat could be maintained over the long-term during nonspill years with an average annual supply of 65,750 acre-feet in these years. This is 2,400 acres less than the targeted 12,500 acres. The amount of wetland-habitat provided in Stillwater Marsh during spill years would also be less than it would be for other alternatives. The wetlands at the delta of the Carson River would be enhanced to the same extent that it would under Alternative C. To more accurately mimic natural wetland-habitat conditions, within the constraints of the annual inflow volume of the WRAP EIS and ROD, a long-term average of less than 5,000 acres of wetland-habitat could be sustained. This approach would fall far short of attaining the 14,000-acre target.

August monitoring of wetland-habitat under this Alternative would markedly overestimate the actual average amount of wetland-habitat being sustained, but quarterly monitoring would slightly underestimate the average amount (Table 4.10).

4.3.3.2 Wetland Delivery and Incidental Inflow

Under the water-rights acquisition program for Lahontan Valley wetlands, the Service, State of Nevada, and other parties will ultimately have an average supply of 125,000 acre-feet per year to sustain a long-term average of 25,000 acres of wetland-habitat in Stillwater NWR, Carson Lake, and the Fallon Paiute-Shoshone Indian Reservation. This will entail four major sources of water supply: Carson River water deliveries, agricultural drainwater, spills from Lahontan Reservoir, and groundwater. Of the four sources, only Carson River water deliveries represent an actual deliverable demand on surface-water resources in the Lahontan Valley. Carson River water deliveries will consist of acquired Carson Division water rights (purchase, exchange, donation, and transfers from Naval Air Station-Fallon), leased Carson Division water rights, and acquired Segment 7 water rights. Acquired water rights are more secure than leased water rights, drainwater, and spillwater. An average inflow of 125,000 acre-feet of water represents baseline conditions, although it may take 20 years to complete the program.

For the purposes of this Draft EIS, Stillwater NWR is assumed to receive 56 percent of the amount to be obtained from each source as delineated in the WRAP Final EIS (USFWS 1996a). Therefore, up to 42,000 acre-feet of Carson Division water-rights and up to 12,190 acre-feet of Segment 7 (middle Carson River) water rights will be acquired for Stillwater NWR wetlands, of which a combined total of about 38,200 acre-feet per year would be available for wetland deliveries. Supplementing this would be water rights transferred from the Naval Air Station-Fallon (up to 3,290 acre-feet) and as many as 12,100 acre-feet of Carson Division water rights to be leased in low-water years, no water rights would be leased in spill years. In total, up to an average of about 43,700 acre-feet per year of delivered water is estimated to reach the Stillwater NWR wetlands upon completion of the program. As of March 1999, about 19,650 acre-feet of Carson Division water rights have been acquired for Stillwater NWR. Wetland deliveries are defined as scheduled irrigation deliveries to the Stillwater NWR (and other primary wetland areas). They include water rights obtained in fee-title and leasing within the Carson Division, and water-rights obtained in fee-title from the middle Carson River (Segment 7).

Delivery of this water will supplement an estimated 11,200 acre-feet per year of drainwater, 5,700 acre-feet per year of spillwater, and up to 7,800 acre-feet per year of groundwater for Stillwater NWR (baseline conditions). Drainwater inflows include seepage, tailwater, and other sources that are incidental to agricultural irrigation deliveries. All drainflow figures for analysis are calculated estimates based on Below Lahontan Reservoir Model assumptions and are used for comparative purposes only. Drainflows could change due to variables, such as drainflow assurances or other changes in water management in the Carson Division of the Newlands

Project. The volume of drainwater entering Stillwater NWR wetlands could be affected slightly be water management at Stillwater NWR. Given the existing volume of water rights that have been acquired so far in the Carson Division, an estimated 15,000 acre-feet per year is estimated to flow into Stillwater NWR under existing conditions.

Spillwater is estimated to reach the wetlands in 24 out of 95 years. In years when spills occur, an average of about 24,400 acre-feet of water would reach Stillwater NWR wetlands. Spills refer to precautionary and operational releases from Lahontan Reservoir for safety reasons, as well as accidental spills. They do not include releases to satisfy irrigation or wetland water demands. Spills provide a potentially large, but intermittent and unreliable, source of water for wetland areas in Lahontan Valley. Whether spills occur depends on many factors including snowpack in the Sierra Nevadas, amount of carry-over water in Lahontan Reservoir, and the timing, rate, and duration of run-off. Whether spill-water reaches the primary wetland areas, and the amount of spill-water that reaches these areas, depends on many factors including the timing and volume of the spill, limited capacity of canals leading to primary wetland areas, partial or total use of these canals to convey water to farmland (a frequent occurrence), and the ability of wetland managers to capture and route spill-water through the wetlands.

Spills are routed through Newlands Project canals and drains. Most spills are controlled and do not result in flooding. Currently, wetlands at Stillwater NWR can safely receive a maximum of 700 to 800 acre-feet/day of water (or about 450 cfs at any given time) during spills, while Carson Lake wetlands can receive about 450 to 500 acre-feet per day, even during periods when larger water volumes are available. For example, in response to flood conditions, more than 40,000 acre-feet of water was released from Lahontan Reservoir during the period of January 3 to 31, 1997. Of the total released, about 14,000 acre-feet (approximately 35 percent) was directed to Stillwater NWR and Carson Lake due to restricted carrying capacities of project canals delivering water to the wetlands. The remainder of the spilled water flowed through the lower Carson River to Fallon NWR and into the Carson Sink. During a flood in 1995, Stillwater NWR and Carson Lake were able to capture 20 percent of the total spill volume due to concurrent agricultural deliveries that reduced TCID's ability to route spill-water to the wetlands. Canal capacity is the largest constraint to making water deliveries prior to March. Conveyance of spill-water to the wetlands after this point is limited by (1) conveyance of excess water to farmlands, (2) delivery of irrigation water to farmlands, and (3) limited canal capacity. The primary wetland areas are at the end of the Newlands Project water-delivery system.

Because spills occur on an infrequent and irregular basis, and because only a portion of spills actually reach wetlands, they are incorporated into the average annual wetland inflow volumes as "useable spills". The frequency and volume of calculated "useable spills," based on the 95-year hydrologic simulation period, are affected by reservoir storage levels and carryover (which are linked to diversion, irrigation demand and deliveries).

The volume of water to be delivered to Stillwater NWR and other primary wetland areas, as identified in the WRAP EIS, would not be affected by any of the alternatives considered in this Draft EIS, except as noted under Alternatives B and D. However, given the pressures to minimize the acquisition of Carson Division and middle Carson River water rights in fee-title, the tendency to spread water too thin must be checked regardless of which alternative is implemented.

Alternative A: Under this alternative, baseline conditions, the total amount of water rights needed to sustain the targeted acreage would remain unaffected. The amount of water flowing into Stillwater NWR wetlands would increase from an estimated average of 39,900 acre-feet/year to an estimated average of 70,000 acre-feet/year (USFWS 1996a,b), or a 75 percent increase. Drainwater inflows would decline from an estimated average of 16,000 acre-feet/year under existing conditions to 11,200 acre-feet/year (30 percent reduction), and the average annual "useable spills to Stillwater NWR would decline by about 1,200 acre-feet/year, a 17 percent reduction (Table 4.11). In an average spill year, an estimated 22,800 acre-feet of water would enter the refuge. Spills are estimated to occur in 24 years out of the 95-year hydrologic period under existing and baseline conditions, or one of 4 years. Changes in drainwater and spill-water inflow under this alternative's seasonal delivery pattern were evaluated in the WRAP EIS (USFWS 1996a). The estimated wetland water demand under this alternative would be about five acre-feet/acre/year, as identified in the WRAP EIS (USFWS 1996a).

Table 4.11. Potential effects of alternative delivery schedules on long-term average volumes of water to be acquired from different sources (expressed in average acre-feet per year).

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
Deliveries					
Carson Division[A]	17,000	43,600	43,600	43,600	43,600
Segment 7	0	up to 3,500	up to 3,500	up to 3,500	up to 3,500
Drainwater	16,000	11,200	10,900	11,000	11,300
Spill-water	6,900	5,700	6,100	5,900	7,100
Groundwater	0	3,800-8,000	0-3,000	3,800-8,000	3,800-8,000
Additional Water	n/a	n/a	n/a	n/a	up to 13000[B]
TOTAL	39,900	70,000	64,400	70,000	86,300

[A] Includes leased water rights and Naval Air Station-Fallon conserved water (assumed to average about 3,200 acre-feet per year)

[B] Could include additional groundwater, or additional leased or acquired Carson Division water rights.

Alternative B: Under this alternative, water demand would be somewhat less than it would be under Alternative A because higher wetland-habitat acreages would be maintained during periods of lower evaporation while seasonal lows in wetland-habitat acreage would occur during periods of high evaporation. The water demand would be an estimated 4.7 acre-feet/acre/year (e.g., 65,750 acre-feet of water would sustain 14,100 acres of wetland-habitat in nonspill years), meaning that an estimated 7,500 acre-feet less water may be needed during nonspill years to sustain 12,500 acres of wetland-habitat. This could reduce the targeted volume of water (long-

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term average of 70,000 acre-feet/year for Stillwater NWR) by as much as 5,600 acre-feet/year. Due to contaminant concerns, groundwater would be the first water source to be reduced from Alternative A (Table 4.11). Under Alternative B, drainwater flows to Stillwater NWR wetlands would decline from existing conditions by an estimated 32 percent, as compared to the 30 percent decline estimated for Alternative A. The average annual "useable spills" to Stillwater NWR under Alternative B would decline by an estimated 12 percent, compared to the 17 percent decline estimated for Alternative A. In an average spill, about 24,400 acre-feet would enter the refuge, slightly higher than Alternative A. Wetland deliveries would not be adversely impacted by irrigating farmland on Stillwater NWR because wetland water-rights would not be used for this purpose.

Alternative C: The amount of water rights needed to sustain the targeted acreage would remain unaffected under this alternative, similar to Alternative A. Drainwater flows to Stillwater NWR wetlands would decline from existing conditions by an estimated 31 percent, as compared to the 30 percent decline estimated for Alternative A. The average annual "useable spills" to Stillwater NWR under Alternative B would decline by an estimated 14 percent, compared to the 17 percent decline estimated for Alternative A. In an average spill, about 23,600 acre-feet would enter the refuge, slightly higher than Alternative A. This does not, however, account for any additional volume of spill-water that could be accommodated if the capacity of canals leading to the refuge is increased. To the extent that additional spill-water increases wetland-habitat acreage, it would result in less water being needed from other sources, such as groundwater. Wetland deliveries would not be adversely impacted by irrigating farmland on Stillwater NWR because wetland water-rights would not be used for this purpose. The water demand of 5 acre-feet/acre/year would be similar to the No Action Alternative.

Alternative D: Under this alternative, which would assume a long-term average 6.4 acre-feet/acre/year water demand (slightly reduced due to a lower demand in spill years) and assuming additional drainwater and spill-water being available (as compared to Alternative A), up to an additional 13,000 acre-feet per year of water may be needed over the long term to sustain a long-term average of 13,500 acres of wetland-habitat in Stillwater Marsh (Table 4.11). A higher water demand would result from larger wetland-habitat acreages being provided during a period of high evaporation and low acreages being provided during a period of low evaporation, as compared to Alternative A. A higher amount of groundwater (higher than identified in the WRAP EIS) could be used to offset the deficiency, but additional leasing or acquisition of Carson Division water rights would also be needed. Drainwater flows to Stillwater NWR would decline from existing conditions by about the same amount estimated to occur under Alternative A. The average annual "useable spills" to Stillwater NWR could increase slightly (an estimated 2.9 percent), as compared to the 17 percent decline under Alternative A. In an average spill year, about 28,400 acre-feet in an average spill year. As with Alternative C, this does not account for any additional volume of spill-water that could be accommodated if the capacity of canals leading to the refuge is increased. To the extent that additional spill-water increases wetland-habitat acreage, it would result in less water being needed from other sources (e.g., groundwater) under this alternative.

Mitigation Measures: The slightly lower estimated volumes of water flowing into Stillwater NWR from drainwater under Alternatives B and C could be mitigated by increased spill-water flowing into the refuge by enlarging the capacity of canals leading to the refuge (see mitigation under Section 4.2.2.6).

4.3.3.3 Seasonal Wetland-habitat Acreage And Water-level Fluctuations

For the purpose of this Draft EIS, four seasons were broken out as follows: January-March, April -June, July-September, and October-December. The following assessment focuses on three of these seasons, corresponding to important life-history stages of wetland wildlife: April-June (nesting season), July-September (early: brooding period; and later: shorebird migration), October -December (waterfowl migration and wintering) (Table 4.9). The evaluation of impacts in this section assumes that a long-term average of 12,500 acres of wetland-habitat would be sustained during nonspill years in all alternatives.

As explained in the previous section, differences between alternatives would primarily occur during nonspill years and, therefore, this section focuses on these years. Under estimated existing conditions, wetland-habitat acreage would range from 5,800 acres in late summer to 7,200 acres in winter during a full-water, nonspill year. April-June acreage would be an estimated average of 6,700 acres and during October-December it would be an estimated average of 6,800 acres.

Water-level fluctuation is one factor affecting plant and invertebrate communities, which has the potential to affect vertebrate (fish, bird, and mammal) communities. This fluctuation likely had a considerable influence on plant and animal communities under natural conditions. Under these conditions, water levels rose during January-March if they had dropped the previous year, or remained at a high level if water levels did not drop considerably the previous year. In years when water levels were high coming into April, the spring pulse of Carson River water would have raised water levels somewhat during April-June in high water-years. If water levels had dropped considerably the previous year, water levels would have risen during April-June. In all years, water levels would have dropped or remained stable during July-September. Most years would have seen declining water levels during this period. If this did not occur on Stillwater Marsh, it would have occurred somewhere in the valley. Water level fluctuations during October-December were variable, depending on water levels leading into this period and volumes of water flowing into Stillwater Marsh.

Water-levels can be fluctuated substantially in particular wetland units while maintaining a relatively consistent wetland-habitat acreage through the year. As an example, water levels in some wetland units can be dropped considerably while the overall wetland-habitat acreage of Stillwater NWR remains at a constant level. However, this would require raising the water level in other wetland units to offset the reduced acreage in the units specified above.

The following assessment does not address spill-years, when water-levels increase considerably when spill-water begins flowing into the Stillwater and Fallon NWRs. Spill-water can flow into the refuges during any month between November and June. Spills, including precautionary releases, resulting from an individual flood generally do not last more than two or three months. The assessment only addresses effects in Stillwater Marsh, and does not include the wetlands at the delta of the Carson River, lower Carson River, Stillwater Slough, or Leter Reservoir. Potential effects of the alternatives on the lower Carson River and its delta wetlands, and Stillwater Slough are discussed under the Vegetation section. Also, the lower Carson River and the wetlands at its delta (now within Fallon NWR) are generally only inundated in spill years.

Alternative A: Under the No Action Alternative, wetland-habitat during a full-water, nonspill year would range from a low of about 12,100 acres in September to a peak of about 13,100 acres in December (Table 4.9). In April-June, an estimated average of 12,500 acres would be available, an increase from existing conditions of about 87 percent. In most years, the increase in flow rate into Stillwater NWR during this period would be just enough to offset evapotranspiration, and therefore most wetland units would not experience rising water-levels during April-June (Table 4.12). The June peak shown for this alternative would not be substantial and could be alleviated by taking more water in late March and April.

Wetland-habitat acreage would decline somewhat during July-September, but increased deliveries during this period would offset much of the effects of evapotranspiration. Water levels in some wetland units would decline, while in others water levels would remain stable.

There would be an estimated 12,300 to 13,100 acres of wetland-habitat during October-December, an increase of about 87 percent compared to existing conditions. Water could be managed under this alternative in a variety of ways, including lowering some units during this period in order to raise water-levels in lower units.

Alternative B: Variability in wetland-habitat acreage from season to season would, compared to Alternative A, increase slightly under this alternative (primarily by lowering acreage during July-September, the season of highest evapotranspiration) (Table 4.9). April-June acreage during a full-water, nonspill year would increase from existing conditions by an estimated 97 percent, compared to the 87 percent increase of Alternative A. Water levels would decline in most units during this period, although some units could be stabilized (Table 4.12).

Under this alternative, wetland-habitat acreage would reach an annual low in about July, and would increase through the July-September period. Wetland-habitat acreage would increase over existing conditions by about 68 percent, which is lower than the increase anticipated for Alternative A (an estimated 107 percent increase). In contrast to Alternative A, nearly all units would see rising water levels through this period, especially the latter end, and declining water levels would occur only on a limited basis.

October-December acreage would increase over existing conditions by an estimated 100 percent, compared to an 87 percent increase under Alternative A. By December, there were would be 1,500 or more acres than would occur under Alternative A. Many units would experience rising water levels during the fall and winter (Table 4.12).

Alternative C: Under this alternative, seasonal fluctuation would be considerably higher than under Alternatives A and B. Wetland-habitat available during April-June in a full-water, nonspill year would increase 1.5-fold (150 percent, or about 10,000 acres) over existing

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Table 4.12. Potential effects of alternative water-delivery schedules on long-term average annual and seasonal wetland-habitat acreages in Stillwater Marsh during nonspill years, assuming a target of an average of 12,500 acres of wetland-habitat in nonspill years (and 16,500 acres in spill years to result in 13,500 acres/year on average).

		Estimated Average Conditions					
		Existing (for comparison)	(No Action) Alternative A	Alternative B	Alternative C	Alternative D	Natural (for comparison)
Water-level Fluctuations:							
Jan-Mar	Stable/Declining:	majority	majority	majority	few	some	some
	Rising:	few	few	few	nearly all	many	many
Apr-Jun	Stable/Declining:	all	nearly all	all	all	few	some
	Rising:	none	few	none	none	majority	many
Jul-Sep	Stable/Declining:	majority	majority	few	majority	all	all
	Rising:	few	few	majority	few	none	none
Oct-Dec	Stable:	most	few	many	~1/3	few	few
	Declining:	none	none	few	~1/3	many	none-some
	Rising:	few	few	many	~1/3	none	some
Estimated Flow Rate (cfs)							
Operational		30-150	30-150	30-150	50-450	50-375	*70-2,000*
Spill (maximum)		450	450	450	800-1,000	1,000	4,000-10,000

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conditions, as compared to the 87 percent increase estimated for Alternative A (Table 4.9). As compared to Alternative A, the amount of wetland-habitat available in April-June would be an estimated 36 percent higher (about 4,500 acres of additional habitat). Wetland-habitat acreage would peak in late March or early April, and acreage would decline from this point through the breeding season, although water deliveries could be managed to attain a slightly lower peak to sustain more stable water levels through June (Table 4.12). Thus, water levels would remain stable or would decline during April-June in all wetland units in nonspill years under this alternative.

There would be an estimated 70 percent increase from existing conditions in July-September wetland-habitat, as compared to the 107 percent increase estimated for Alternative A. As compared to Alternative A, there would be about 17 percent fewer wetland-acres during this period. However, the amount of wetland-habitat available during the brooding period would be higher under this alternative and water levels would decline more during shorebird migration than under baseline management (Table 4.12).

During October-December, wetland-habitat acreage would increase over existing conditions by an estimated 54 percent. As compared to Alternative A, there could be up to an estimated 17 percent less wetland-habitat during October-December. However, the water-delivery schedule is flexible enough to provide nearly as much wetland-habitat during October-December as could be provided under Alternative A (within 10 percent). Water levels during this period would decline in some wetland units, rise in other units, and remain stable in still other units (Table 4.12).

Alternative D: Seasonal fluctuations in wetland-habitat acreage and water levels would be higher under this alternative than under any other alternative. Wetland-habitat available during April-June in a full-water, nonspill year would nearly triple (increase of 190 percent, or by about 13,000 acres) as compared to existing conditions (Table 4.9). As compared to Alternative A, the amount of wetland-habitat available in April-June would be about 57 percent higher (an estimated 7,100 acres of additional habitat). Wetland-habitat acreage would nearly double during April-June, peaking in June. Water levels would rise fairly quickly during this period in many wetland units (Table 4.12).

Under this alternative, July-September acreage of wetland-habitat would more than double as compared to existing conditions (165 percent increase), compared to the 107 percent increase that would occur under Alternative A. Compared to Alternative A, there would be about 28 percent more wetland-habitat during this period. The amount of wetland-habitat available during the waterbird brooding period would be higher under this alternative and water levels would decline more during shorebird migration than they would under baseline management, or any other alternative. All units would experience dropping water levels under this alternative (Table 4.12).

During October-December, wetland-habitat acreage could decline from existing conditions by an estimated 15 percent (about 1,000 fewer acres), but with some flexibility in the delivery schedule, wetland-habitat provided during this period could be comparable to estimated existing conditions (Table 4.9). As compared to Alternative A, there would be about 54 percent less wetland-habitat during October-December (about 6,900 fewer acres). Water levels during this period would decline in most wetland units, but would remain stable in limited areas (Table 4.12).

Mitigation Measures: Significantly fewer wetland-habitat acres would be provided under Alternative D during October-December. Alternative C could also result in a somewhat lower acreage during this period. Mitigation could include shifting the water-delivery pattern in a way that favors higher volumes of flow being delivered during the late summer and fall. Although flexibility is built into each alternative's seasonal delivery pattern, changes beyond the specified ranges would result in a delivery-pattern of a different alternative being implemented (e.g., Alternative A or B). Another potential mitigation measure would be to use some of the water delivered in fall and winter to create temporary shallow-water habitat during these seasons, which would allow larger acreages to be sustained during the fall and winter, a period of low evaporation. Mitigation could also include providing additional waterfowl foraging areas in the agricultural lands.

4.3.3.4 Flushing Action and Wetland Water Chemistry

Seasonal wetland inflow rate (inflow volume per unit area of wetland-habitat) of Carson River water (as opposed to drainwater) also influences wetland-habitat and other elements of marsh ecology by flushing salts and reducing total dissolved solids concentrations in wetland water. Flushing of dissolved and suspended solids may also remove potentially toxic trace elements from some wetlands. Under natural conditions, peak runoff during April-June resulted in four to 16 acre-feet of water flowing into Stillwater Marsh for every acre of wetland-habitat during this three-month period. In general, about 80 to 90 percent of the water flowed through Stillwater Marsh and out into the Carson Sink during this season (during years when the Carson River flowed directly into Carson Lake or Stillwater Marsh). This resulted in a tremendous amount of water replacement, which flushed salts and other dissolved and suspended solids from many areas of the marsh. Wetland inflows reached an annual high of 1,000 to 2,500 cubic-feet-per-second (cfs) even in low water years. During large floods, peak inflows into Stillwater Marsh may have exceeded 10,000 cfs.

During the late summer and fall, the amount of water flowing into the marsh dropped off considerably, especially during August, September, and October (the lowest water inflow period). Wetland inflow during this time would have dropped to an estimated 70 to 150 cfs, even during low water years. When the Carson River flowed directly in Carson Lake, water flow into Stillwater Marsh would have ceased during August-October in most years. Under natural conditions during October-December and January-March, wetland inflows would have increased somewhat over the previous season, but would have remained fairly low until March.

Upstream water diversion and the discharge of agricultural drainwater have contributed to increased total dissolved solids and trace element concentrations entering Stillwater NWR. Trace elements are discussed in the next section. High levels of total dissolved solids and high pH levels do not equate to poor water quality. For example, several native invertebrates thrive in waters that exceed the "effect" level for total dissolved solids, and many thrive in waters that

exceed the Nevada State pH standard for propagation of aquatic life and wildlife (Table 4.1). In a recent study, brine shrimp and brine flies were found to inhabit waters exceeding total dissolved solids concentrations of 30,000 mg/L, and brine flies, brine shrimp, and some species of mosquitos inhabit waters with pH values exceeding 10 (Bundy 1996). However, even though brackish water conditions are a natural component of the Lahontan Valley wetland ecosystem, extensive freshwater wetlands, including marsh and river, is a critical component of the wetland ecosystem. Historically, Stillwater Marsh was a relatively freshwater marsh.

Elevated concentrations of total dissolved solids is attributed to a combination of factors that resulted in the modification of the way water flows in the Carson River basin. Following development of the Newlands Project and regulation of the Carson River, inflow of fresher water directly from the Carson River was reduced and the inflow of irrigation drainage containing elevated dissolved solids was increased. Increased irrigation efficiencies mandated under OCAP further reduced the inflow of fresh water. Because of reduced inflows, wetland acreage declined. During the late 1980s, about 10 percent of the historic wetland acreage remained. Concentrations of dissolved solids in wetlands increased due to increased dependence on irrigation drainage. Dependence on drainwater resulted in a shift in water delivery patterns to wetlands, with inflows to wetlands corresponding to the release of irrigation water from Lahontan Reservoir over the agricultural growing season. Reduced inflow of water resulted in the hydrologic isolation of some wetlands while diking and flow regulation within the wetlands disrupted the flow-through character and increased the hydrologic retention time of other wetlands. Such changes reduced the frequency and efficiency of flushing of dissolved solids through the wetlands and some constituents became concentrated in wetlands through evaporative processes.

Limited flushing has allowed these materials to accumulate in wetlands, which has shifted Stillwater Marsh from a freshwater marsh to a more alkaline or saline marsh. Therefore, restoration of the flushing characteristics is vital to the restoration and maintenance of the natural biological diversity on Stillwater NWR. Under existing and baseline conditions, the volume of water that can be received during spill years will dictate the reestablishment of effective flushing of the wetlands. However, potential benefits of flushing must be weighed against potential detriments. Although increased flows during periods of flooding would help to flush dissolved and suspended solids through the wetlands, flood water from the Carson River contain elevated concentrations of mercury that are mobilized from upstream bank and bottom sediments during high water. The relationships between flushing of dissolved and suspended solids from Stillwater Marsh and the loading of mercury to the marsh are as yet to be worked out. Further research is needed to more fully understand the actual effects of mercury on wetland wildlife.

Water released from Lahontan Reservoir is derived from both the Carson and Truckee Rivers and is characterized as calcium-sodium-bicarbonate or sodium-sulfate type water. Dissolved solids concentration in released waters generally range from 150 mg/L to 500 mg/L.

Under all alternatives, water chemistry of any particular area within Stillwater Marsh would vary considerably from season to season and from year to year, and water chemistry would vary even more markedly from one end of the marsh to the other. Given this highly variable nature of water chemistry, only broad scale differences between alternatives can be examined.

Alternative A: As additional water rights are acquired, the concentration of total dissolved solids in the wetlands would decline. Water in the refuge's wetlands under baseline conditions, assuming completion of the water-rights acquisition program, would be substantially more fresh than under existing conditions.

Under the ongoing water-rights acquisition program, wetland inflow would be provided by deliveries of Carson River water, agricultural drainwater, and spills, but would also consist of other sources, such as groundwater pumping to meet the 14,000-acre wetland objective for Stillwater NWR. As established in the WRAP EIS, groundwater could be used to the extent that it does not adversely impact the quality of wetland inflow. Groundwater in the Carson Lake and Stillwater NWR area where pumping may occur has a high level of total dissolved solids and trace elements (Maurer et al.1994). Groundwater total dissolved solids concentrations from wells in Stillwater NWR area range from 4,000 mg/L to 8,000 mg/L (Maurer et al. 1994), which is four to eight times higher than drainwater inflow to the wetlands.

Using these values, a rough estimate of the quality of wetland inflow was calculated using weighted averages. Under the water-rights acquisition program, up to 10 percent of the 70,000 acre-foot program is anticipated to consist of groundwater and about 70 percent of the total wetland inflow would consist of Carson River water (i.e., irrigation water). At this level of groundwater pumping, concentrations of total dissolved solids and trace elements could be comparable to that of than existing conditions.

Alternative B: Concentration of total dissolved solids in wetlands would decline from existing conditions to the same degree as would occur under Alternative A.

Alternative C: Concentration of total dissolved solids in wetlands would decline from existing conditions to the same degree or a higher as would occur under Alternative A. Long-term average concentrations of total dissolved solids may be slightly lower than would occur under Alternative A to the extent that higher volumes of water pass through the marsh during spill events. Total dissolved solids concentrations in upper wetland units would, over the long-term, be lower than those expected under Alternative A. Rates of flow through Stillwater Marsh would be higher, seasonally, than would occur under Alternative A.

Alternative D: Concentrations of total dissolved solids and rates of flow through the marsh would be similar to those of Alternative C.

4.3.3.5 Environmental Contaminants in Wetlands

Previous investigations identified concerns with un-ionized ammonia, and 12 trace elements in water, sediment, and biological samples from Stillwater NWR (Table 4.13). The trace elements aluminum, arsenic, boron, and mercury were identified as contaminants of primary concern. The occurrence of environmental contaminant concerns in Stillwater NWR wetlands is largely

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attributed to human modification of natural hydrologic characteristics and processes of wetlands, and wetland water supplies. Contaminants at concentrations identified in water, sediment, and biological samples from Stillwater NWR have the potential to produce a range of direct and indirect adverse effects to fish, wildlife, and habitat quality in Stillwater NWR. Effects may stem from direct toxicity of water and sediment, or may result from exposure of higher organisms to elevated concentrations through food chains. Potential effects to organisms may include altered behavior, biochemical and histological effects, immunosuppression, reduced growth, reduced reproductive success, malformation of embryos, and mortality. Interactive effects of these contaminants may also modify toxicity and organism response. Effects at higher levels of biological organization are more difficult to quantify. However, certain contaminants, at levels found on Stillwater NWR, have been associated with community level effects, such as loss of habitat variability, reduced species abundance and diversity, and effects to community functions.

Table 4.13. Chemical elements of concern in water, sediment, and biological matrices collected from four wetlands on Stillwater NWR, 1986-1996. "S" indicates that >10% of the samples exceeded water quality standards or criteria; "E" indicates that >10% of the samples exceeded a level associated with an adverse biological effect; "C" indicates >10% of the samples exceeded a biological concern level; "N" indicates that <10% of the samples exceeded water quality standards or biological effect or concern levels; and "-" indicates that data were not available.

				Avian Diet				
Constituent	Water	Sediment	Whole Fish	Vegetation	Invertebrate	Fish	Avian Egg	Avian Liver
TDS	S, E	-	-	-	-	-	-	-
Ammonia	S, E	-	-	-	-	-	-	-
Aluminum	S, E	-	-	E	E	N	-	-
Arsenic	S, E	C	C	E	N	N	-	N
Boron	S, C	-	-	E	C	C	N	E
Chromium	N	N	C	C	C	C	-	N
Copper	N	N	C	-	-	-	-	-
Lead	S, C	C	C	N	N	N	-	N
Mercury	S, E	E	E	E	E	E	E	E
Molybdenum	S, C	-	-	N	N	N	N	N
Selenium	N	C	N	N	C	C	N	C
Zinc	E	N	C	N	N	C	-	N

Previous investigations in Lahontan Valley identified aluminum, arsenic, boron, mercury, and selenium as trace elements of primary concern in Lahontan Valley wetlands (Table 4.13). Aluminum concentrations in a large percentage of food chain organisms exceeded levels associated with adverse effects to avian species. Concentrations in food chain organisms correlate with concentration in sediment, suggesting that aluminum in the food chain originates from sediment. Aluminum concentrations in wetland sediments are uniformly high throughout

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Lahontan Valley, including wetlands unimpacted by human activities. As such, high concentrations of aluminum in wetland components probably reflect natural soil conditions. High concentrations of aluminum in sediment combined with the lack of correlation with water suggests that little can be done to alleviate elevated aluminum in the wetland food chain.

Arsenic concentrations in wetland water, sediment, and vegetation commonly exceeds concentrations associated with adverse effects to sensitive aquatic invertebrates, fish, amphibians, and birds. Correlations between arsenic concentrations in unfiltered water and concentrations in sediment and vegetation suggest that reducing water-borne arsenic would contribute to reduced arsenic concentrations in these other wetland components. The correlation between total dissolved solids and arsenic in unfiltered water suggests that arsenic in the water column could be achieved by controlling dissolved solids.

Boron concentrations in aquatic vegetation and invertebrates commonly exceed levels associated with adverse effects to avian species. Boron concentrations in pondweed correlate with sediment. However, concentrations in sediment and pondweed do not correlate with concentrations in unfiltered water. The lack of correlation suggests that managing wetlands with higher quality water may not eliminate concerns with boron in aquatic vegetation.

Selenium is generally not detected in water samples from Stillwater NWR. Concentrations in biological samples are not indicative of selenium contamination or impaired avian reproduction. Research in other areas has demonstrated that the increased flow of fresh water to wetlands has reduced concerns with selenium contamination. Therefore, it is likely that water acquisition will further reduce selenium concerns on Stillwater NWR.

Mercury, which exceeds fish and wildlife effect concentrations in water, sediment, food chain organisms, fish, and bird tissues, represents the greatest hazard to avian species in Lahontan Valley. Additionally, concentrations in fish and certain bird tissues exceed concentrations recommended for human consumption. Although mercury concentrations are highly elevated in Lahontan Valley, direct effects to wildlife appear less than expected when compared with other mercury-contaminated areas. Mercury concentrations in sediment correlate with concentration aquatic invertebrates and vegetation, suggesting that food chain contamination originates from sediment. Although correlations were not significant, mercury concentrations in fish and bird tissues are generally higher in wetlands with higher concentrations of mercury in sediment. Because sediments act as both a sink and a source of mercury in aquatic systems, the acquisition of water is unlikely to mitigate mercury contamination. Therefore, other measure will be needed to reduce fish and wildlife exposure and the potential for adverse effects.

As indicated in section 4.2.1, the Service is currently working in conjunction with the EPA, the USGS, and the University of Nevada, Reno, to identify measures to reduce mercury transport and wildlife exposure. Several potential measures to reduce wildlife exposure are under consideration. Some potential management options are offered below. Continuing investigation will enable the refinement of some alternatives or the development of others.

Like contamination of the refuge, the highest concentrations of mercury in sediment are found in wetlands most closely associated with historic Carson River channels. Therefore, a de-emphasis on the management of wetlands with the highest levels of contamination (e.g., west side of the refuge) coupled with an emphasis on the management of wetlands further removed from historic channels (i.e., wetlands on the eastern side of the refuge) may reduce wildlife exposure to mercury. Additionally, natural depressions on the east side of the refuge offer the opportunity to create wetlands in uncontaminated areas.

Sampling in the Carson Lake area has demonstrated that the highest levels of contamination are associated with surficial sediment. Therefore, wildlife exposure to mercury in some wetlands may be reduced through the removal of surficial sediment. Cost of off-site disposal of contaminated sediment may be prohibitive, therefore on site disposal, such as burial or capping, may be necessary.

The toxicity of mercury depends on chemical form. Organic forms of mercury (e.g., methylmercury) are considered the most biologically available and most toxic forms. The methylation of inorganic mercury generally occurs in or near aquatic sediment. The rate of mercury methylation (and subsequent demethylation) is controlled by a variety of factors, including microbial activity, oxygen availability, concentration of organic carbon, concentration of oxyanions such as selenium and molybdenum, and concentrations of mercury. On-going research by the USGS and the EPA is attempting to characterize dominant factors controlling methylation and demethylation rates in Stillwater NWR wetlands. Results of this research may provide additional options for controlling wildlife exposure to mercury. Additionally, changes in hydrologic regime, such as desiccation and reflooding of wetlands, may enhance mercury methylation rates. The Service, in conjunction with EPA, expects to evaluate the effects of such hydrologic changes to methylation rates on Stillwater NWR. Findings of this investigation may provide additional management options to reduce fish and wildlife exposure to mercury on Stillwater NWR.

Although all alternatives are expected to benefit the quality of water delivered to Stillwater NWR, differences among alternatives may results in relatively minor variations in water chemistry. Potential differences are discussed below.

Alternative A: The acquisition of water is expected to reduce concerns with most environmental contaminants in the wetlands of Stillwater NWR. As indicated under Section 4.3.3.4, (Flushing Action and Wetlands Water Chemistry), groundwater may be used to supplement water supplies to Stillwater NWR. Concentrations of arsenic, boron, selenium, and other potentially toxic trace elements in groundwater in the Stillwater NWR area are comparable to, or higher than, drainwater (Hoffman, 1994). The use of poor quality groundwater may increase the loading of dissolved solids and trace elements in refuge wetlands. Increased loading may exacerbate contaminant exposure and adverse effects, as compared to existing conditions.

Alternative B: Because of a lower reliance on groundwater, this alternative may reduce the concentration and loads of agricultural-related contaminants entering the refuge. Lower concentration and loads may contribute to a lower potential for aquatic life and wildlife toxicity. Conversely, the bulk of the water is delivered during the summer. Therefore, less freshwater is available to dilute concentrated drainwater or dissolved constituents accumulated and concentrated in wetland water. As a result, nesting and hatchling birds may be exposed to higher contaminant concentration, which could lead to lower nesting success and recruitment.

Alternative C: Under this alternative, concentrations of total dissolved solids and trace elements associated with agricultural drainage would be expected to be lower in wetlands higher on the hydrologic gradient. Therefore, exposure to, and effects from these contaminants would be expected to be lower in these wetlands as compared to Alternative A. As such, the potential to reestablish populations and communities sensitive to elevated dissolved solids and trace elements would be enhanced. Conversely, the increased use of water spilled from Lahontan Reservoir during flooding may increase the loading of mercury to the refuge, which may exacerbate concerns with mercury.

Alternative D: Full simulation of the historic hydrological conditions would result in the more efficient movement of dissolved constituents though sequential wetlands. Like Alternative C, contaminant exposure in wetlands higher on the hydrologic gradient would be reduced and the potential to reestablish sensitive organisms would be increased. Conversely, the increased reliance of ground water may offset some of these potential benefits. Again, an increased use of spill water during floods may contribute to the increased loading of mercury to the refuge.

Measures to Reduce Contaminant Loading of Wetland Inflows

No adverse impacts, above and beyond baseline conditions, would be expected under any of the alternatives. Nevertheless, due to ongoing contaminant concerns, several measures were identified that would improve the quality of inflow into the primary wetlands, as compared to baseline conditions. Improving drainwater quality over existing conditions would benefit the Stillwater NWR wetlands under all alternatives. Eliminating or closing drains that are known to produce poor quality water, such as TJ Drain, would reduce the impacts associated with poor quality drainwater reaching the primary wetlands. Structural improvements could be made to prevent groundwater seepage, an identified source of contaminants, from entering the deeper drains. Water-management strategies could be carried out to dilute drainwater by adding better quality water (this would be done as part of any alternative). Routing of poor quality drain water to wetlands lower on the hydrologic gradient would reduce total dissolved solids in wetlands higher on the hydrologic gradient (also a component of all alternatives). Wetlands higher on the hydrologic gradient historically supported many saline intolerant species.

Implementation of measures recommended by the Department of the Interior's National Irrigation Water Quality Program (USDI 1985) to improve drainwater quality would reduce the adverse effects associated with use of drainwater for wetlands protection. Eliminating drains can be accomplished by retiring the irrigated lands adjacent to problem drains. One method to retire irrigated lands would be to enact an acquisition strategy that would focus wetland water right acquisitions in irrigated areas where poor quality drainwater occurs. Currently, there is insufficient data to identify those irrigated lands contributing to drainwater quality problems.

Potential water quality impacts associated with use of groundwater for wetlands protection can be lessened by reducing reliance on groundwater, or by locating wells in areas with better water exist. If less than 6 percent of groundwater is used or, if to supplement wetland inflows, it is estimated that degradation of water quality of wetland inflow would not occur -- water quality of wells would be tested initially and monitored to ensure that water quality of wetland inflow would not be impacted by using groundwater. The actual amount of groundwater that could be used before water quality begins to deteriorate would depend on the characteristics of the water being pumped from a particular well. In effect, this mitigation would constrain the scope of the current water-rights acquisition program by limiting, or eliminating, groundwater use, but would avoid the possible adverse effects associated with greater reliance on groundwater for wetland protection. This strategy can be implemented under the framework of the existing water-rights acquisition program by placing more reliance on acquiring water from other sources, such as increasing canal capacity to convey greater volumes of spill-water to the refuge during spills and acquiring additional middle Carson River corridor water rights.

Locating wells closer to the City of Fallon, or on the west side of the Carson Division of the Newlands Project could potentially provide better quality water for wetlands protection. The intermediate aquifer north and northwest of Fallon has total dissolved solids concentrations that range from 100 mg/L to 1,000 mg/L, which is comparable to water quality that would result under the other action alternatives.

However, down-gradient groundwater-users could be adversely impacted by groundwater pumping in this area, which encompasses most Churchill County water-users. In addition, pumping in the recharge zones of the intermediate aquifer west and northwest of Fallon would most likely affect recharge of the basalt aquifer which provides water for the City of Fallon, the Naval Air Station-Fallon, and the Fallon Paiute-Shoshone Tribes. Because of the many potential adverse impacts associated with locating wells in these areas, it is unlikely that the Service would choose to implement such mitigation.

4.4 BIOLOGICAL COMMUNITIES

Extensive references to scientific and other information were not used in Chapter 4 in order to enhance readability. Two literature reviews were conducted to address to sources of effects on wildlife and their habitat: potential effects of human disturbance (Appendix L) and potential effects of livestock grazing on wildlife and habitat (Appendix M). Another report included as an appendix identifies the major underlying problems limiting achievement of refuge purposes, and also summarizes pertinent scientific literature on the effects of these underlying problems (Appendix N). Evaluations of the alternatives on vegetative communities, and resulting populations of wildlife, relied heavily on a spreadsheet model developed to estimate monthly wetland-habitat acreages under each alternative under several different representative water years, or stages of the water-rights acquisition program (Appendix I). The basis of the numbers used in this model is described in Appendix H. Compatibility determinations in Appendix O can be consulted for more detailed information on the potential effects of public uses, livestock grazing, and farming practices on wildlife and habitat.

4.4.1 Vegetation

Vegetation is covered in four main sections: basin-wetland, riparian-wetland, upland, and agricultural. The first two address wetland vegetation communities. Forty-nine wetland plant communities have been identified within lacustrine (lake), palustrine (marsh), and riparian wetland areas in Lahontan Valley (Bundy et al. 1996). Forty-four of these can still be seen within the Lahontan Valley landscape; however, five historically described communities were not sampled during recent inventories (Donohue and Baumgartner 1995, Bundy et al. 1996, Charlet et al. 1998). While the communities were not sampled, dominant species within these communities were observed suggesting that these associations could reestablish given suitable wetland conditions.

Three different types of upland communities are addressed, encompassing 22 different vegetative communities. There are a number of possible agricultural vegetative communities that can exist on Stillwater NWR, depending on what is planted.

Because the action alternatives would not result in any significant adverse impacts to vegetation, no mitigation measures were identified, except where noted.

4.4.1.1 Basin-Wetland Plant Communities

Generally, the basin-wetland plant communities fall into six main categories, each associated with different water depths and salinity levels. The categories are:

- **Submergent marsh** - Dominated by various species of pondweed, *Chara* and wigeon grass;
- **Deep emergent marsh** - Dominated by hardstem bulrush, cattail, pondweed, and duckweed;
- **Shallow emergent marsh** - Dominated by alkali bulrush, common three-square, and common cane
- **Moist-soil** - Dominated by five-hook bassia, swamp timothy, summer cypress, wild millet, smartweed, and red goosefoot;
- **Wet meadow** - Dominated by wirerush, sedges, spikerush, water clover, muhly grass, and saltgrass;
- **Shrub** - Dominated by greasewood, quailbush and saltgrass; or saltcedar with variable understories.

Three additional habitat types which typically are not vegetated include:

- **Unvegetated alkali mudflat;**

- **Deep-open water;**

- **Playa** - typically unvegetated but can include components of all previously mentioned types through longer periods of flooding.

The preceding list describes common plant communities occupying each wetland-habitat type encountered at the Stillwater NWR complex. Habitat types are arranged in order of decreasing water demands and water depth. While water depth and permanence generally dictate distribution of habitat types, other factors, such as salinity, regulate the plant communities and species which occupy a given type. The following discussion provides descriptions of the wetland plant communities found within each habitat type, the communities which may have been present historically, and possible reasons for any changes. All descriptions are based on intensive field surveys conducted during the summers of 1993 (Donohue and Baumgartner 1995), 1995 (Bundy et al. 1996), and 1997 (Charlet et al. 1997).

These field surveys were used to provide estimates of wetland-habitat acreages and percentages under estimated existing and baseline conditions. Existing conditions assume an annual average of 6,600 acres of wetland-habitat in the Stillwater Marsh while baseline conditions assume an annual average of 12,500 acres at completion of the water rights acquisition program (not including spill years).

Submergent Marsh: Submergent vegetation is typically located in more permanently flooded sections of Stillwater NWR and requires higher amounts of water to maintain. At present, this habitat type represents 10 to 35 percent of Stillwater NWR marsh habitat and is comprised of western pondweed, sago pondweed, wigeongrass and horned pondweed submergent vegetation communities (Table 4.14). While these species represent the most common plant community members in submergent habitats, other species, such as long-leaved pondweed, mosquito fern, and duckweed are often encountered.

Historically described communities, no longer present on the Stillwater NWR complex, include the coontail and watermilfoil submergent vegetation communities. These species typically require less saline water than currently exists and have likely declined in response to less frequent flushing water flows. However, both water milfoil and coontail have been observed in other parts of the Lahontan Valley where fresher water inputs occur. It is likely that submergent vegetation community percentages have increased since establishment of Stillwater NWR as a result of increased amounts of shallow water during the growing season.

Deep Emergent Marsh: Deep emergent marsh is also located in more permanent water and thus, has similar water requirements. This habitat type encompasses about 15 to 30 percent of Stillwater NWR marsh habitats and is comprised of three dominant submergent vegetation

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Table 4.14 Wetland Plant Community Representation by Community Dominants and Community Type Among 21 Plant Communities Sampled on Stillwater NWR, Summer 1995.

Wetland Community Type	Community Dominant(s)		Percent * (Community)	Percent (Wetland Type)
	Scientific Name	Common Name		
Submergent Communities				14%
	Potamogeton filiformis	Western pondweed	6%	
	Potamogeton pectinatus	Sago pondweed	2%	
	Ruppia maritima	Wigeongrass	4%	
	Zannichellia palustris	Horned pondweed	2%	
Deep Emergent Communities				19%
	Scirpus acutus	Hardstem bulrush	5%	
	Typha domingensis	Southern cattail	6%	
	Typha latifolia	Broad-leaf cattail	8%	
Shallow Emergent Communities				20%
	Phragmites australis	Common Reed	2%	
	Scirpus maritimus	Alkali bulrush	18%	
Wet Meadow Communities				4%
	Eleocharis macrostachya	Creeping spikerush	2%	
	Juncus balticus	Baltic rush	2%	
Grass Communities				21%
	Distichlis spicata	Saltgrass	20%	
	Muhlenbergia asperifolia	Muhly grass	1%	
Shrub Communities				8%
	Allenrolfea occidentalis	Iodinebush	4%	
	Sarcobatus vermiculatus	Big greasewood	1%	
	Sarcobatus vermiculatus-	Big Greasewood-	1%	
	Suaeda moquinii	Torrey's seepweed	2%	
Tree Communities				1%
	Populus fremontii	Fremont Cottonwood	1%	
Annual Herbaceous and Invasive Communities				14%
	Bassia hyssopifolia	five-hook Bassia	12%	
	Various Annuals	various annual species	1%	
	Tamarix ramosissima	Saltcedar	1%	

communities; hardstem bulrush, southern cattail, and broad-leaf cattail. Additional species which are often encountered include: alkali bulrush, common three square, and duckweed which are present in transition zones between deep and shallow emergent habitats. In general, these communities form large, homogenous bands with 90 percent of the community consisting of one species.

While deep emergent marsh percentages are similar to historic estimates, changes in species composition have likely occurred in relation to modified hydrology and water salinity levels. Past inventories suggest that this habitat type was dominated by hardstem bulrush while the

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present community structure has shifted toward dominance by the two cattail species (USFWS 1952, Giles 1953, Bundy et al. 1996). It is possible that higher wetland water salinity and decreased water depths have led to this result. This trend has been monitored since the inception of Stillwater NWR and appears to continue at present.

Even within cattail species, there has been a shift in species with several pre 1950s researchers commenting on the abundance of narrow-leaf cattail (Marshall 1949). At this time, southern cattail was just beginning to appear in the marsh landscape and was considered "a newly described species" by Marshall. Narrow-leaf cattail has not been observed in any recent vegetation studies (Bundy et al. 1996, Charlet et al. 1998). While no solid answers are available on this shift, it is possible that narrow-leaf cattail hybridized with broad-leaf cattail, resulting in southern cattail, which may have been better adapted to changing marsh conditions in the Stillwater Marsh.

Shallow Emergent Marsh: Shallow emergent marsh is generally located at the edge of the more perennial submergent and deep emergent habitat types, where water permanence is less stable. This habitat type covers between 10 to 35 percent of the Stillwater NWR marsh area and is comprised of two vegetative communities; alkali bulrush and common cane. Similar to deep emergent communities, these communities typically occur in homogenous bands with few other species present, and generally in low percentages. Examples of other observed species include five-hook bassia, red goosefoot, and bearded sprangletop which are indicative of fluctuating water levels and, with the exception of bassia, adapted to fresher water.

This habitat type has likely increased from historical conditions, likely because less water enters the refuge, creating more fluctuation in water levels. Additionally, higher salinity levels have led to increased dominance by the alkali bulrush community which appears to thrive in highly saline environments (Bundy et al. 1996). In the current Stillwater NWR marsh system, more than 90 percent of the shallow emergent habitat type consists of this species.

Moist-soil: Moist-soil habitats are recently described in the Stillwater Marsh; however, some form of this community likely existed prior to Newlands Project development. Typically resulting from summer draw downs on unvegetated mudflats, species encountered include five-hook bassia, summer cypress, swamp timothy, and a variety of other annual weeds and grasses. Since each species has a different set of germination requirements, such as soil salinity, soil temperature, day length, and soil moisture content, timing of draw down is directly related to the species that will grow, thus, managers, through determining water distribution schedules, have more influence on producing desirable plant combinations in this habitat type than all others.

Historically, there would have been portions of the Stillwater Marsh that would slowly dry during summer months through natural evaporation processes. Considering heavy spring water flows preceding this drying period, much of the salt would have been flushed from the marsh creating conditions suitable for freshwater adapted species, such as wild millet, swamp timothy, and smartweed. At present, most of these habitats are covered by salt tolerant exotic species, such as prickly lettuce and five-hook Bassia which covered more than 10 percent of Stillwater NWR marsh habitat in 1995. Therefore, this community likely always existed, but the species commonly associated with moist-soil habitats have shifted form freshwater adapted to salt water tolerant. This habitat type likely covers more marsh area at present than it did historically.

Wet Meadow: Wet meadow habitats are divided into two components based on water depth and permanence: (1) wet meadow communities, consisting of creeping spikerush and baltic rush communities, and (2) grass communities which are dominated by the saltgrass and muhly grass communities. While both groups are best supported by temporary water that is generally limited to spring and early summer months, the two rush communities seem to flourish in relatively deeper water that remains for longer periods. Conversely, saltgrass can survive up to several years without surface water. In combination, all of these communities represent 0 to 30 percent of Stillwater NWR wetland vegetation; however, saltgrass is by far, the most common species in this habitat type.

The amount of area covered by the saltgrass community is probably more extensive than historic estimates suggest. However, the historically described mixed meadow grass community, consisting of foxtail barley, rabbitfoot grass, and wirerush, has not been sampled recently within the Lahontan Valley. This community has likely been displaced by the saltgrass community related to livestock grazing and higher water salinity levels. All historically documented species are currently present in the Lahontan Valley and the mixed meadow grass community type could be restored.

Shrub Communities: Shrubs can occur within any habitat where dry conditions extend through most of the year. As a result, this community type can be present in upland, playa, riverine floodplain, wet meadow, mudflat, and even shallow emergent habitats during extended dessication periods. Common shrub communities associated with refuge wetland-habitats include the iodinebush, big greasewood, and Torrey's seepweed communities. Iodinebush and Torrey's seepweed appear to thrive at higher salinity levels while big greasewood is more of a generalist and is distributed throughout a wider range of salinity. Iodinebush and big greasewood were the only shrub communities sampled in standing water throughout the Lahontan Valley.

At present, shrub communities occupy about 0 to10 percent of marsh habitats; predominately, in seasonally moist bands around the wetlands and within alkali playas. Coverage by shrub communities is likely similar to historic estimates considering that coverage moves with the water line. In other words, as wetlands dessicate through drought cycles, shrub habitat would follow the receding water line. Conversely, as the wetlands expanded through flood periods, they would flood out shrubs in previously dry areas. This pattern is similar to estimated historic functioning of the marsh.

Playa, Deep Open Water, and Unvegetated Alkali Mudflat Communities: Unvegetated habitats occur in a variety of locations throughout Stillwater NWR. At present, salinity levels appear to be the primary driving force as heavy salt crusts are invariably linked to these unvegetated habitats. Examples would be most of the Carson Sink and numerous playas located throughout the current boundaries of the Stillwater WMA and Fallon NWR. These habitats can change with water conditions as repeated high water pulses can lower salinity to concentrations that support

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wetland vegetation. Vegetation within nearly all previously mentioned habitat types can be present during long periods of flooding; however, saltgrass and shrubs are typically the only groups which survive.

It is likely that unvegetated habitat coverage at the Stillwater NWR complex has increased from historic estimates, primarily related to decreased water flows and increased salinity of water inputs. While this trend is evident at Stillwater, other areas of the Lahontan Valley have likely experienced a decrease, related to water depth. At water depths greater than six feet, vegetation establishment is greatly inhibited (Mitsch and Gosselink 1992). As a comparison, a large percentage of the historic Carson Lake (80 percent) was six to ten feet deep when the lake was full. Additionally, portions of Stillwater Slough as it entered and progressed through the historic Stillwater Marsh maintained depths in excess of six feet. No current wetland-habitat at the Stillwater NWR complex exceeds six feet.

Native/Nonnative Dominated Communities: Several wetland plant communities currently present at Stillwater NWR are not representative of the habitats that occurred under natural conditions. For example, several native and nonnative annual forbs have become established along saline mudflats during receding water conditions. Common plants within this habitat type include five-hook Bassia, kochia, red goosefoot, swamp timothy, sea purslane, and several other annual grasses and forbs. These habitats probably did not exist during the pre-Newlands era, at least not in their present form. However, there appears to be some wildlife benefits related to the forage base provided by these plants.

Another factor related to annual forb abundance is the increase in the number of nonnative plant species. At present, 72 of 192 recognized wetland species have been introduced into the Lahontan Valley; most of which are annual forbs and grasses. While these annuals appear to have at least some habitat value to native wildlife, other species, such as saltcedar, have spread and formed large homogenous blocks that exclude native plant establishment. Saltcedar will continue to be a management concern at Stillwater NWR along with tall whitetop and the potential encroachment of purple loosestrife. Similar to saltcedar, these two species can form large homogenous bands that inhibit growth of native species. Tall whitetop has been observed on Stillwater NWR while purple loosestrife has been documented on the Truckee River canal.

Effects of Alternatives

Wetland vegetation undergoes a variety of cyclic events. Percentages of a given habitat type within wetland complexes change by year, season, and vary in geographic location between years in relation to timing, amount, salinity, and alkalinity of water input. Therefore, the percentages and ranges in percentages identified in this section should be viewed with an understanding of these factors. The rough estimates offered throughout the wetland-habitat section represent our best understanding of habitat conditions, given the available vegetation data, and estimates of what would happen during an average, nonspill year under each alternative. The estimates are presented for the purposes of assessing gross differences between alternatives.

Wetland-habitat is the portion of a wetland basin that contains surface water at any given time (i.e., after water has evaporated from a part of a wetland basin, this part of the basin no longer provides wetland-habitat). Therefore, acreages of wetland-habitat change seasonally relative to different water-management strategies outlined under each alternative. Conversely, wetland basins are lands that are at least periodically saturated or covered with water (Cowardin et al. 1979). Acreages of wetlands are the same each year, regardless of water-management scenarios. Therefore, wetland basins are the areas that could potentially be flooded while wetland-habitat is the portion of the basin that is flooded at a given time.

The following discussion focuses on habitats in the Stillwater Marsh complex which is located in the existing Stillwater NWR. Additional wetland-habitat occurs at Fallon NWR and throughout the Stillwater WMA, primarily in the Indian Lakes area. Most of this habitat is seasonal and would not be greatly affected by the alternative water-management strategies, with the exception that the Carson River delta on Fallon NWR could benefit from completion of the water-rights acquisition program and use of water for riparian restoration. At present, this delta wetland complex only receives water during spill years (an estimated one of four years) and provides considerable flood-plain meadow and riverine channel habitats when floods occur. The Indian Lakes area is not within any of the action alternative boundaries, but the lakes would continue to provide unique habitats and plant communities during spill years.

Spill years would have much wider range of effects on habitat composition than the average conditions presented in the following discussion. More seasonally flooded habitat types, such as wet meadows and greasewood, would be temporarily flooded during spill years, which would increase their overall acreage and their percent coverage during spring. Habitat conditions in Stillwater Marsh during spill years would be much more influenced by the volume of water entering the marsh as a consequence of the spill than they would be influenced by the alternative that is implemented. However, to the extent that off-refuge canal capacity is increased (to accommodate the additional water-rights being acquired and possibly to convey larger volumes of spill-water) and on-refuge water-conveyance facilities are enlarged (Alternatives C and D), there could be some differences in effects among alternatives.

The following discussion considers gross differences in the amount of different habitat types that would occur under each alternative. All comparisons are based on water modeled estimates for an average, full-allocation water-year assuming completion of the water-rights acquisition program. These differences are presented and compared to existing conditions in Table 4.14.

Assumptions When Comparing Alternatives: Considering the dynamic nature of Great Basin wetland complexes, readers should recognize that estimates identified in the following discussion are for comparative purposes only. This was found to be the simplest way to communicate gross differences among alternatives. Vegetation changes with differing environmental conditions with wet areas in one year supporting different vegetative species in subsequent years where dry conditions prevail. This is particularly true with seasonal habitats where flooding/drying cycles vary almost every year. The assumptions used in estimating the response of vegetation to the alternatives is described below.

First, in making comparisons, we only estimated conditions that would occur in an average, full-allocation, nonspill water-year, assuming completion of the water-rights acquisition program. It is assumed that spill events would tend to equalize the alternatives. Estimates of total wetland-habitat acreage during full-allocation, nonspill years were derived from a spreadsheet computer model (Appendix I). Although model outputs only depict average conditions, it is recognized that average conditions are not a normal occurrence in a Great Basin wetland complex. Variability is the rule rather than the exception, and it is assumed that this variability would affect each alternative similarly.

Second, factors contributing to vegetative germination and growth were considered. It was assumed that timing, duration, salinity, and alkalinity of water inputs have the most direct effects on the type and amount of vegetation produced by a given alternative's water-management strategy. While information is available for many of Stillwater NWR's plant species, all of the factors involved in the continued presence of a particular plant or set of plants within a given habitat type or plant community are not known. Experimentation, which is ongoing in Stillwater Marsh, is an important means to obtain this information.

Third, through analysis of vegetation studies conducted over the last 60, we identified a range of habitat type distributions that could occur from year-to-year and within a seasons based on vegetation response to hydrologic conditions that have occurred in recent years. These conditions were extrapolated to the larger acreages of wetland-habitat estimated for each alternative, accounting for seasonal differences in acreages and other factors. Estimates are provided in Table 4.15.

In Table 4.15, the percent of marsh habitat that would be seasonally wetted, the number of acres associated with this acreage (presented as a range), and the season when peak wetland-habitat acreage would be anticipated are presented for each habitat type. The percentages are a combination of annual and seasonal estimates, which allow for variability during both periods. Acreage ranges were calculated by multiplying the estimated seasonal peak water availability (at the top of each column) by the estimated proportion of the marsh comprised of that particular habitat type during that season. Similar calculations were performed with low periods to establish range highs and lows. Where peak seasons were similar, the range was multiplied by 12,500 acres which is the estimated average annual acreage of total wetland-habitat produced under all alternatives during nonspill years in Stillwater Marsh.

With seasonal habitats, including shallow emergent through shrub habitats, we are assuming the peak season generally corresponds to the peak acreage. Conversely, permanent habitats, such as submergent and deep emergent habitats do not always follow this trend, particularly when it is assumed that low acreage during fall would result in the highest habitat percent coverage, but the lowest acreage (particularly with Alternative D). The assumption is that under all alternatives, water would never be completely removed from these permanent water zones. Thus, acreage would remain relatively constant through seasons. Removal of other habitat types through drying would increase the percentage of permanent water habitats simply because that is all that remains.

Table 4.15. Estimates of percent representation, acreage, and seasonal peak for habitat types in wetland units of Stillwater Marsh.

Habitat Type **Annual** **Spring** **Fall**		**Existing** **6,600** **6,700** **6,800**	**Alternative A** **12,500** **12,500** **12,700**	**Alternative B** **12,500** **13,200** **13,700**	**Alternative C** **12,500** **17,000** **10,500**	**Alternative D** **12,500** **19,600** **5,800**
Deep, Open Water	%	0-1	0-1	0-1	1-4	2-5
	acres	0-67	0-125	0-132	105-680	116-980
	Peak	Spring	Spring	Spring	Spring	Spring
Submergent	%	10-40	20-40	15-30	20-35 [1]	20-50
	acres	660-2640	2500-5080	1320-4110	2100-3675	2900-3920
	Peak	Similar	Similar	Fall	Similar	Similar
Deep Emergent	%	15-30	15-30	15-30	15-40	15-45
	acres	990-1980	1875-3750	1980-5010	2550-4200	2610-2850
	Peak	Similar	Similar	Fall	Similar	Similar
Shallow Emergent	%	10-35	10-25	10-30	10-30	0-35
	acres	660-2310	1250-3125	1320-4110	1050-5100	0-6860
	Peak	Similar	Similar	Fall	Spring	Spring
Moist-Soil	%	10-30	5-15	15-30	10-25	0-20
	acres	670-2040	625-1905	1980-4110	1050-4250	0-3920
	Peak	Fall	Fall	Fall	Spring	Spring
Wet Meadow	%	0-20	0-10	5-15	10-25	0-30
	acres	0-1360	0-1250	660-2055	1050-4250	0-5700
	Peak	Spring	Spring	Fall	spring	Spring
Unvegetated Mudflat	%	5-10	5-10	5-10	5-15	0-15
	acres	330-660	625-1250	660-1370	525-2550	0-2940
	Peak	Similar	Similar	Fall	Late Spring	Late Spring
Shrub	%	0-5	0-5	0-3	0-5	0-5
	acres	0-330	0-625	0-411	0-850	0-980
	Peak	Similar	Similar	Fall	Spring	Spring

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[1] Both submergent and deep emergent habitats under Alternatives C and D portray acreage estimates that are likely an underestimate of actual acreages. The calculation used in this table assumes that the high seasonal acreage will correspond to the high seasonal proportion which does not account for the large seasonal acreage fluctuations in these alternatives. The actual high acreage range likely exceeds these estimates.

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4.4.1.1.1 Submergent Vegetation

Under existing conditions, submergent vegetation is estimated to cover 10 to 40 percent of wetland-habitat in Stillwater Marsh during nonspill years (660 to 2640 acres). Most plant species within this type are salt tolerant and can survive in water ranging from a few inches deep to three to four feet. Most wetland units within Stillwater NWR and Fallon NWR have at least some submergent vegetation, with any given wetland unit's percent cover directly related to the amount of permanent water available in the unit and the amount of emergent vegetation carried over from the previous year. Because water management under existing conditions focuses on maintaining habitats through all seasons, little change in percent cover would occur seasonally. Some freshwater-associated plant communities, such as coontail and water milfoil are no longer present in Stillwater Marsh.

Alternative A: Similar to existing conditions, stable water management would produce little variability in seasonal percent of total wetland-habitat in Stillwater Marsh (20 to 40 percent). However, because the amount of wetland-habitat available during nonspill years would nearly double by the time the water-rights acquisition program is completed, the amount of submergent vegetation would also double, up to an estimated 2,500 to 5,080 acres.

Alternative B: This alternative would result in slightly lower amounts, 15 to 30 percent of the total wetland-habitat acreage on Stillwater Marsh, or, an estimated 1,320 to 4,110 acres, of submergent vegetation compared to Alternative A, due to summer drawdown and the fall-water-management emphasis. However, the amount of submergent vegetation would be higher than under existing conditions. With less perennial water during the growing season, as compared to Alternative A, there would be less suitable habitat for submergent vegetation germination and growth; thus, there would be less submergent vegetation on an annual basis.

Alternative C: An emphasis in simulating the natural hydrologic regime would result in a shift from more salt tolerant submergent vegetation communities, such as wigeon grass and chara, to more freshwater tolerant, such as western pondweed, sago pondweed, and the historically-described coontail community. Overall, percentages would be similar to baseline with 20 to 35 percent (2,100 to 3,675 acres) of Stillwater Marsh's wetland-habitat in submergent vegetation, meaning that the amount of this habitat would double as compared to existing conditions. A relatively low emphasis on wetland burning could allow deep emergent vegetation to encroach into areas producing submergent vegetation. However, muskrat grazing is anticipated to keep deep emergent vegetation in check, and limited controlled burns would also be used for this purpose.

Alternative D: Similar to Alternative C, there would be an anticipated shift from salt tolerant to fresher water associated communities under Alternative D. Conversely, the minimal amount of fall water inflow would result in less acreage of submergent vegetation during fall and winter, as compared to Alternative A, but a higher percentage of submergent vegetation in remaining wetland-habitat. Under Alternative D, an estimated 5,000 acres of wetland-habitat in Stillwater Marsh would remain during the fall and winter, of which greater than 50 percent would probably consist of submergent vegetation (2,900 acres).

4.4.1.1.2 Deep Emergent Vegetation

Under existing conditions, deep emergent vegetation is estimated to cover 15 to 30 percent of wetland-habitat during nonspill years (990 to 1980 acres). While only three primary species occur within this habitat type, broad-leaf cattail, southern cattail, and hardstem bulrush, emergent vegetation forms the foundation of the wetland complex and provides numerous benefits for the seasonal needs of wetland-dependent wildlife. Past monitoring efforts provide evidence that hardstem bulrush once dominated this habitat type; however, increasing salinity, alkalinity, and decreased water depth have led to increased dominance by the two cattail species. Similar to submergent vegetation, deep emergent vegetation requires permanent water for germination and survival and is typically present, at least to some extent, in every wetland unit every year.

Alternative A: With water management similar to existing management, deep emergent vegetation would cover 15 to 30 percent of Stillwater Marsh's wetland-habitat under baseline conditions, nearly doubling existing acreage (1,875 to 3,750 acres), as compared to existing conditions. With increases in available water and the resulting "freshening" of the system, there would be an anticipated shift in community dominance with hardstem bulrush slowly increasing in coverage. Because little variability in wetland-habitat acreage would occur under this alternative, little change in seasonal acreage and percent coverage would be anticipated under Alternative A. Some units would be periodically drained through management prescription under Alternative A; however, acreage would be maintained as some units are flooded while others are drawn down.

Alternative B: Similar to Alternative A, 15 to 30 percent of wetland-habitat on Stillwater Marsh would be covered by deep emergent vegetation (1,980 to 4,110 acres). Under this alternative, the water-management focus would be on the need to provide fall habitat which would result in wetland drawdowns at a time conducive to deep emergent vegetation growth and establishment. This could result in deep emergent vegetation encroaching into areas consisting of submergent habitat. However, burning of residual vegetation would be used to keep percentages in check. Seasonal evaporative drawdowns would reduce coverage during the summer. A higher amount of wetland-habitat during the fall, as compared to Alternative A, would result in all of the emergent vegetation zone being covered with water during this period.

Alternative C: Under Alternative C, a slightly higher amount of deep emergent vegetation could occur during spring and early summer, as compared to that which would occur under Alternative A. An estimated 15 to 35 percent (2550 to 4200) of wetland-habitat on Stillwater Marsh would be covered by this type. The slightly higher amount compared to Alternatives A and B is related to higher spring flows and lower emphasis on controlled burning (as compared to Alternative B) which may result in deep emergent vegetation encroachment into other habitat types. It is anticipated that muskrat grazing will keep this encroachment in check while limited prescribed burning would be used when muskrat populations are low. Similar acreages would occur during spring and fall periods, as adequate water would be available in the fall.

Alternative D: Wide seasonal ranges in total wetland-habitat acreages would be anticipated under this alternative, with annual percentages of deep emergent vegetation ranging from 15 to

45 percent of Stillwater Marsh's wetland-habitat (2610 to 2850 acres). As water recedes during summer and early fall, it is unlikely that water would be completely removed from the deep emergent habitat type. Therefore, acreages would decrease slightly into the fall while the overall percentage would increase, due to markedly lower wetland acreage during the fall and winter. Approximately 30 to 45 percent of remaining fall wetland-habitat would be in deep emergent vegetation (1500 to 2250 acres). Lack of controlled burning could increase emergent vegetation encroachment into other habitat types; particularly, into submergent vegetation. However, muskrat grazing would keep this in check when muskrat populations are high.

4.4.1.1.3 Shallow Emergent Vegetation

Under existing conditions, shallow emergent vegetation ranges widely in relation to the amount of water entering and evapotranspirating from the refuge's marshes in any given year. This habitat type requires shallow water conditions to germinate and once established, can survive in shallow water or dry conditions. At present, germination sites are made available through natural summer evaporative drawdowns which are typically reflooded during fall when evapotranspiration rates go down. An estimated 10 to 35 percent of Stillwater Marsh's wetland-habitat, 660 to 2310 acres, is occupied by shallow emergent vegetation under existing conditions.

Alternative A: Although water management would remain similar to existing conditions, there would be an anticipated decrease in shallow emergent vegetation due to increased flow of irrigation-quality water into wetland units. Less evaporative drawdown would occur resulting in more stabilized water levels throughout summer months, leaving less shallow water habitat for germination and growth. Approximately 10 to 25 percent (1250 to 3125 acres) of wetland-habitat acreage on Stillwater Marsh would be covered by this habitat type. Although overall percentages would decrease from existing conditions, acreage would be somewhat higher than existing due to the increased wetland-habitat acreage.

Alternative B: This alternative would likely be the best for shallow emergent vegetation growth and availability during the fall. Water management would be focused toward shallow water levels during summer and higher levels during fall, which would provide optimal conditions for this vegetation. Approximately 10 to 30 percent (1320 to 4110 acres) of wetland-habitat on Stillwater Marsh would be comprised of shallow emergent vegetation. Little change in percentages or acreages would occur between fall and spring, and therefore would be similar to Alternative A.

Alternative C: Similar to Alternative B, summer evaporative drawdowns would provide optimal conditions for shallow emergent vegetation germination and growth. However, much of this habitat type would not be reflooded during the fall, resulting in seasonal differences. An estimated 10 to 30 percent of Stillwater Marsh's wetland-habitat (1,050 to 5,100 acres) would be comprised of shallow emergent vegetation, with fall percentages below baseline and spring percentages above baseline. Although spring wetland-habitat acreage (up to an estimated 18,000 acres in April) would be considerably higher than baseline, a substantial portion of the water applied during the spring would be used to decrease salinity and would end up in northern units,

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such as Big Water, where little vegetative growth would be anticipated. Nearly all shallow emergent vegetation established during summer evaporative drawdown would be reflooded during the spring.

Alternative D: This alternative would produce the highest amount of shallow emergent vegetation, up to 35 percent (6860 acres) of Stillwater Marsh's wetland-habitat in the spring, but as little as zero percent of the wetland-habitat during the fall (i.e., no standing water in the shallow emergent zone in fall). The higher amount of spring wetland-habitat, as compared to Alternative A, would be related to flushing flows during spring months and would result in freshening the Big Water unit. It is anticipated that shallow emergent vegetation would develop in this unit.

4.4.1.1.4 Moist-Soil Vegetation

Moist-soil vegetation represents a relatively new, or at least a modified habitat type in the Stillwater wetlands. Most plant species occurring within this type under existing conditions are nonnative to Lahontan Valley, but they provide substantial benefits to a variety of migrating and wintering waterfowl and other water birds. It is estimated that some form of moist-soil vegetation existed under natural conditions, which was likely comprised of fresh-water adapted annual broad-leaved plants and grasses. Increases in salinity throughout the marsh have likely contributed to a shift toward salt-water tolerant annual plants, most of which are nonnative species. Under existing conditions, approximately 10 to 30 percent (670 to 2,040 acres) of wetland-habitat in Stillwater Marsh is comprised of moist-soil vegetation during nonspill years.

Alternative A: Increased water deliveries to the refuge would tend to freshen the system under Alternative A, which may lead to the establishment of more native species within this habitat type. However, stabilized water throughout the growing season would tend to reduce availability of mudflat habitat which moist-soil plants require for germination and growth. It is anticipated that only 5 to 15 percent (625 to 1,905 acres) of available wetland-habitat in Stillwater Marsh would be comprised of moist-soil vegetation, which represents a slight increase in acreage from existing conditions, but a substantial decrease in percent coverage on an annual basis.

Alternative B: Considerable emphasis would be placed on active management to produce moist-soil vegetation under Alternative B. Wetland-habitats would slowly dry over summer months, producing suitable germination habitat throughout the growing season. Emphasis on fall flooding and maintenance through the winter and spring would make this habitat type available through fall, winter, and spring. It is estimated that 15 to 30 percent (1,980 to 4,110 acres) of Stillwater Marsh's wetland-habitat would be comprised of moist-soil vegetation on an annual basis. This change in management emphasis would result in a much higher acreage of moist-soil habitat as compared to baseline and existing conditions.

Alternative C: Moist-soil vegetation management would be practiced under Alternative C, and while less of this habitat would be provided than under Alternative B, more of this habitat type would be produced than under Alternative A. Approximately, 10 to 25 percent (1,980 to 4,250) of wetland-habitat in Stillwater Marsh would be covered by moist-soil vegetation; however, more would likely be produced, but not flooded during fall and winter months under this alternative. The management focus under Alternative C would provide for evaporative drawdown in most units during summer months. During fall and winter, an average of about one-third of the wetland acreage would be flooded, including wetland areas that had produced moist-soil vegetation during the growing season. Units under each of these water-management options would be rotated periodically.

Alternative D: No emphasis would be placed on producing moist-soil vegetation under Alternative D. Management emphasis would be on simulating the natural hydrology which is estimated to produce mudflat habitat throughout the growing season, but virtually none of this habitat type would be reflooded during the fall and winter. Moist-soil vegetation would be reflooded during the spring, which would provide some benefits to spring migratory waterbirds. Approximately 0 to 20 percent (0 to 3,920 acres) of wetland-habitat in Stillwater Marsh would be comprised of moist-soil vegetation under Alternative D, which would only be wetted during the spring.

4.4.1.1.5 Wet Meadow Vegetation

Under existing conditions, wet meadow vegetation covers a relatively small proportion of annually wetted habitat. However, substantial amounts of wet meadow vegetation can be produced seasonally, particularly in spring, when high water conditions occur over a period of years. This habitat type has changed considerably from natural conditions. Under existing conditions, a single species (inland saltgrass) occupies most wet meadows. At present, approximately 0 to 30 percent (0 to 1,360) of wetland-habitat acreage in Stillwater Marsh is comprised of wet meadow habitat, which is primarily flooded during spring months.

The effects of livestock grazing on meadow vegetation were studied along the lower Carson River in Fallon NWR. Near Battleground Point, five sample plots located inside a 1-hectare livestock grazing exclosure and four of five sample plots located outside the exclosure were characterized in April 1997 as a saltgrass dominated plant community with few other species present. From April 1997 to September 1999, sample plots within the exclosure changed to a more native mix of plant species, with a higher diversity of plant species within the community, while the outside sample plots retained the same vegetative composition throughout this period (Bundy and DeLong In Prep.). The number of species within plant communities, the average amount of the ground covered by vegetation, and the average height of plants within the sample plots were roughly at the time the livestock grazing exclosures were constructed (2.4/3.6 species, 15%/13% ground cover, and 10cm/12cm average height, for inside plots/outside plots respectively), but, these values had changed to 8.4/4.8 species, 72%/61%, and 44cm/20cm by September 1999. Compositional differences were not as apparent on an exclosure located roughly one mile south of the one near Battleground Point. The southern area had fewer grasses and more shrubs, which would not be expected to change to the same degree over the three year sample period.

Concealment cover near ground level (e.g., up to 6-½ inches) was measured inside and outside the north and south livestock grazing exclosures. At the time the exclosures were constructed in April 1997, concealment cover below 6-½ inches was nearly equal between the inside and outside plots for both the northern and southern exclosures. After one growing season, concealment cover remained unchanged outside the livestock grazing exclosure, but increased inside the exclosure at both locations. By the end of the third growing season, concealment cover had more than doubled inside of the exclosure, but still had not changed to any great extent outside the exclosure.

Alternative A: The tendency toward stable water levels under Alternative A would not provide for much seasonal flooding of wet meadow habitats, which is required to maintain these habitats over the long term. Therefore, much of the wet meadow habitat type available at present, would likely slowly change to other habitat types, such as shallow emergent vegetation (for those areas that are annually flooded) or upland vegetation (for those areas not being annually inundated). This would result in low percentages of wet meadow vegetation, estimated to annually range from 0 to 10 percent of Stillwater Marsh's wetland-habitat (0 to 1,250 acres). This habitat would only be wetted during high water periods, related to slightly higher water during spring and late fall months when evapotranspiration is low. Saltcedar would continue to invade this community during spill years followed by drawdown. The seeds for saltcedar are brought in with the flood waters, and when the water is gone, remain in the mud, thus creating new colonies. Cattle grazing in localized areas would continue to keep vegetation short, as shown in the study described above.

Alternative B: There are several possible ways that wet meadow habitats could function under this alternative. With little emphasis on spring flooding, followed by evaporative drawdown, conditions beneficial to development of wet meadow vegetation, it is possible that this habitat type would decrease in distribution. Conversely, fall flooding would be a management focus, which could promote growth of saltgrass. It is thought that this latter scenario would be the likely result, providing flooded wet meadow habitat during fall, but rarely during spring months. Approximately 5 to 15 percent (660 to 2,055 acres) of available wetland-habitat in Stillwater Marsh would be comprised of wet meadow vegetation, occurring almost entirely during fall months. Reductions in cattle grazing pressure would result in a greater diversity of plant species in wet meadow communities and more structural diversity.

Alternative C: This alternative would provide ideal conditions for development and maintenance of the wet meadows. Simulation of natural hydrology would provide spring wetting of wet meadow vegetation, followed by summer evaporative drawdown. Simulation of high spring flows would also freshen water in upper wetland units, which would provide suitable conditions for the development of natural wet meadow communities in addition to saltgrass. Species comprising these other communities have decreased in abundance since Newlands Project development. Additionally, fall water management could provide a minimal amount of wet meadow habitat in some years during fall and winter months, although it is likely that water would not flood this habitat type in most wetland units during the fall. Approximately 10 to 25 percent (1,050 to 4,250 acres) of available wetland-habitat in Stillwater Marsh would be comprised of wet meadow vegetation during the spring. Saltcedar control would stop the expansion of the saltcedar into this habitat and the exclusion of cattle grazing, where it is currently permitted in Stillwater Marsh and at the delta of the Carson River (Battleground Point area), would result in a more natural vegetative community.

Alternative D: This alternative would likely provide the best conditions for maintenance of wet meadows. Full simulation of the natural hydrology would provide the best conditions of any alternative for the restoration of native vegetative composition in wet meadow communities. None of this habitat type would remain flooded from late summer through the early spring, similar to estimated natural conditions (aside from years when flooding occurred). Up to 30 percent (up to 5,700 acres) of Stillwater Marsh's wetland-habitat would be wet meadow habitat during the spring. However, limitations on controlling saltcedar could potentially result in some of this acreage being converted to saltcedar communities. Exclusion of cattle grazing from the locations where it is currently permitted in Stillwater Marsh and at the lower end of the Carson River would result in a more natural vegetative structure in this community.

4.4.1.1.6 Wetland Shrub Vegetation

The wetland shrub habitat type is extremely variable, with shrub habitat following the shoreline during multi-year, drought/flood cycles. Typically related to uplands (and therefore not flood tolerant), some species are transitional between uplands and wetlands and can survive short-term seasonal flooding. Wetland shrubs usually become established during long-term droughts, die off during extended flooding periods, and, in areas where they became established during droughts, typically remain in those areas where short-term, seasonal flooding or no flooding occurs. At present, these habitats can be extensive, covering 0 to 5 percent; 0 to 330 acres of wetland-habitat, related to annually fluctuating water availability. Common wetland shrub communities include big greasewood, iodinebush, and desert blight; however, quailbush, rubber rabbitbrush, and dotted dalea also occur in these communities. The shrub habitat type was likely not as prevalent under natural conditions, except when the entire Stillwater Marsh remained dry for extended periods. Natural wetland shrub communities have likely been displaced by invasive saltcedar throughout much of their historic range.

Alternative A: Stable water management under Alternative A would not provide for extended dry periods throughout the Stillwater Marsh, resulting in little establishment of a wetland shrub habitat. This habitat type would only be found along wetland shorelines, and would only be flooded during periodic spill years. Annual drying periods would not be sufficient to maintain shrub habitats as many species require several years to mature. Therefore, approximately 0 to 5 percent (0 to 625 acres) of available wetland-habitat in Stillwater Marsh would be comprised of shrubs. Very little saltcedar control would be practiced in this habitat type.

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Alternatives B, C, and D: While these alternatives would all provide drawdown conditions during summer months, where shrubs could potentially establish, seasonal flooding provided under each alternative would not provide suitable conditions for maturation of shrubs. Some seasonal habitat might be provided; however, only a thin strip of shoreline habitat would be maintained which would likely only comprise 0 to 5 percent (0 to 980 acres) of available wetland-habitat in Stillwater Marsh. Shrub habitat could be flooded periodically under Alternatives B and C when wetland units are reflooded after several dry years. There would be a slight decrease in shrub habitat from baseline under all alternatives. However, higher levels of invasive vegetation control would be practiced under Alternatives C and D.

4.4.1.1.7 Unvegetated Alkali Mudflat Habitat

At present, considerable wetland-habitat acreage can be covered by unvegetated alkali mudflats. Highly saline water is strongly related to development of this habitat type, as it occurs in areas where salt contents exceed levels where wetland vegetation can survive. Although wetland vegetation is absent, this habitat type is quite valuable for migrating shorebirds and will continue to provide habitat for a number of other waterbird species. Large open flats can currently be seen throughout most of the northern refuge units; however, only a portion is wetted at any given time. Approximately 5 to 10 percent (330 to 660 acres) of Stillwater Marsh's wetland-habitat is seasonally comprised of unvegetated alkali mudflat habitat, particularly during summer and early fall.

Alternative A: Under this alternative, water-management focus would be on sustaining marsh vegetation. While unvegetated alkali mudflat habitats would continue to be a component of the overall wetland complex, less water fluctuation would occur under this alternative, which would result in a constant unvegetated alkali mudflat zone as opposed to the more productive fluctuating zone provided under summer evaporative drawdown conditions. Similar to existing conditions, approximately 5 to 10 percent of unvegetated alkali mudflat habitat would still be provided, but the amount would increase to an estimated 675 to 1,250 acres. However, the value of this habitat to wildlife would be altered somewhat because water level fluctuations would be reduced.

Alternative B: Under this alternative, acreages and percentages would be similar to Alternative A (5 to 10 percent; 660 to 1370 acres). However, under Alternative B, a higher proportion of the unvegetated alkali mudflat habitat would be characterized by new areas of alkali mudflat being exposed by receding water during evaporative summer drawdowns. In other words, as water recedes, a band of this habitat would follow the shoreline, exposing new areas over time. Based on the shape of wetland depressions, the width of this band would increase as water receded; however, the length would decrease as wetland acreage decreased. Therefore, equal availability of unvegetated alkali mudflat habitat would be available throughout the summer. As water levels increase during fall flooding, the same progression would occur in reverse, but the quality of this habitat for shorebirds would be reduced because of the previous waterbird use of habitat during summer drawdown. As a result, unvegetated alkali mudflat habitat for shorebirds would primarily be available during summer months under Alternative B.

Alternative C: There are a few possible outcomes with unvegetated alkali mudflats under Alternative C, which would vary in relation to the salinity and alkalinity of water entering the wetlands. First, it is likely that simulation of the natural hydrology and associated summer drawdown would result in a similar progression to that described under Alternative B. However, because Alternative C would result in lower salinity in wetland units, which would allow marsh vegetation to become established on many of these mudflats. Much of the excess water used to reduce water salinity would flow out to the Big Water unit, where an additional alkali mudflat habitat would become established. Therefore, approximately 5 to 15 percent (525 to 2,550 acres) of summer wetland-habitat in Stillwater Marsh would be occupied by this habitat type. Overall, this alternative would provide for higher acreages of unvegetated alkali mudflat than baseline but less fall acreage than under Alternative B, although there would be more receding mudflat habitat under Alternative C than there would be with rising water levels in Alternative B.

Alternative D: Full simulation of the natural hydrology would increase potential for producing vegetation on mudflats through wetland units. However, implementation of this alternative would also increase acreage on the Big Water Unit, and thus, provide seasonally higher acreages and percentages than under Alternative C (0 to 15 percent; 0 to 2,940 acres). At peak water flow during early summer, the higher end of this range would be achieved. No fall flooding of this habitat would be anticipated under Alternative D.

4.4.1.1.8 Deep, Open-Water Habitat

Under existing conditions, virtually no deep, open-water habitat is available. Open water habitat is defined as being devoid or nearly devoid of vegetation and typically greater than six feet deep; however, low water clarity can reduce this depth to three to four feet. Related to an inconsistent water source, water depths which would inhibit growth of submergent and deep emergent vegetation are currently not maintained. In some years and in some wetland units, this habitat is produced seasonally with high water inflows; however, vegetation will typically establish in these seasonal zones as the summer progresses. It is estimated that less than 3 percent (0 to 200 acres) of Stillwater Marsh's wetland-habitat is comprised of deep, open-water habitat at present.

Alternative A: Even with increased water inflow related to the water-rights acquisition program, it is unlikely that deep, open-water habitat would be maintained under this alternative. In some years and wetland units, it is possible that this habitat type would occur seasonally; however, only 0 to 3 percent (0 to 400 acres) of available wetland-habitat in Stillwater Marsh would be comprised of deep, open water. This habitat would be seasonal, as submergent and deep emergent vegetation would become established as the summer progressed.

Alternative B: This alternative would be similar to baseline (Alternative A).

Alternative C: Through simulation of the natural hydrology, an increase in deep, open-water habitat would be anticipated under Alternative C. Similar to Alternative A, this habitat type would be seasonal in most locations; however, it is possible that some channels would be restored through wetland units which would produce additional deep, open-water habitat, as compared to Alternative A. Approximately 1 to 4 percent (105 to 680 acres) of available wetland-habitat in Stillwater Marsh would be maintained.

Alternative D: This alternative would produce the highest percentage of deep, open-water habitat. Through full simulation of the natural hydrology and restoration of channels through some wetland units, approximately 2 to 5 percent (116 to 980 acres) of available wetland-habitat in Stillwater Marsh would be maintained as deep, open-water. Although much of the seasonal habitat would become vegetated during summer evaporative drawdown it is anticipated that channels would remain unvegetated throughout the year.

4.4.1.1.9 Playa Habitats

At present, playa habitats are distributed throughout Stillwater NWR, Fallon NWR, and Stillwater WMA. Including the Carson Sink (within Stillwater WMA and Fallon NWR), seasonally flooded playa habitats account for the largest acreage of Stillwater WMA and Fallon NWR wetland-habitats. The scattered alkali playas not receiving water from the Carson River are more closely tied to local precipitation and shallow groundwater movement and annual rainfall. These playa habitats are typically closed basins with overland flow limited to the immediate surrounding uplands. Therefore, the timing of flooding would not change markedly under any of the alternatives, with the exception that increased inflows to wetlands after completion of the water rights acquisition program, might raise the shallow groundwater table in some locations, thus, increasing the duration of playa habitat flooding. To the extent this is true, Alternative D would result in the largest increase in seasonal playa habitat acreage.

Boundary revisions, associated with different levels of protection afforded playa habitat, would have the most marked effect on this habitat type (Table 4.16). Each alternative would incorporate a different amount of playa habitats. Although Alternative A would retain the most acreage of playa habitat within a Federal wildlife area, this alternative along with Alternative B would provide the least protection to playa habitat. Alternatives C and D would protect playas from livestock grazing and would afford additional protection from off-road vehicles.

Table 4.16. Approximate acreage of playa habitat included under each alternative are as follows, excluding the Carson Sink.

Alternative	Playa Acres Included
A	8,900 acres
B	4,520 acres
C	6,450 acres
D	8,470 acres

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4.4.1.2 Riverine Riparian Plant Communities

Historically, the banks of the Carson River in the Lahontan Valley were dominated by cottonwoods, willows, cattails, buffaloberry, grasses, rushes, and sedges. At present, saltcedar and Russian olive, which are introduced and highly invasive species, also inhabit riparian areas. Both native and introduced species occur along the Carson River corridor and along a few project drains and canals. Cottonwoods have become more widespread in the valley due to the high water table and the use of the trees for landscaping and windbreaks. Buffaloberry, a valuable forage and cover shrub, has been nearly eliminated from the affected area as a result of clearing and grazing.

While these drains and canals provide additional riparian habitat outside refuge boundaries, the Carson River corridor provides the majority of riparian habitat within the refuge. Habitat along the river corridor can be divided into several different categories based on water depth, water permanence, and geographic location. These categories include:

- **Riverine Channel** - permanently flooded portion of the river corridor dominated by duckweed, cattails, hardstem bulrush and sandbar willow.

- **Seasonal Overflow Habitats** - includes the river bank, oxbow lakes, and floodplain habitats dominated by various trees, shrubs, grasses, and previously mentioned wetland plants.

- **Riverine Delta** - located at the end of the Carson River as it enters the Carson Sink, dominated by saltgrass, sea purslane, alkali bulrush, cattails, and hardstem bulrush.

At this time distribution of riparian habitat is seasonal with annual snowpack and associated flows down the Carson River regulating habitat abundance. During low water years, few of these habitats would become or remain flooded during spill years, all habitats would remain flooded for some portion of the year. Therefore, riverine systems likely contain the most dynamic habitats at Stillwater NWR which are potentially the most productive. The following discussion is based on recent surveys conducted by Donohue and Baumgartner (1995), Bundy et al. (1996), and Charlet et al. (1998).

Riverine Channel: Historically, the Carson River channel likely maintained at least some flow throughout the year. At present, storage in Lahontan Reservoir and associated diversion have led to seasonal dry periods, often extending through much of the year. However, when flooded, the channel is comprised of a mosaic of wetland species including duckweed, broad-leaved cattail, hardstem bulrush, and sandbar willow. Seasonal high flows can scour the channel, removing residual vegetation and providing germination sites for new plants to grow. This cycle of high pulses followed by periods of drought retains riparian productivity.

At present, periods of drought occur at more frequent intervals. When this occurs, germination sites are provided for a variety of annual forbs and saltcedar. While the forbs generally wash out during spill periods, saltcedar and willows remain. Saltcedar has slowly encroached into native willow habitat reducing willow coverage from historic estimates.

Seasonal Overflow Habitats: During periods of high water flow, the Carson River can overflow its banks producing a mosaic of temporary habitats. Representative examples include tree, shrub, and grass plant communities along the river's bank; wet meadow and shrub communities along the rivers floodplain, and oxbow lakes where the river channel changes in relation to flow patterns. Bank and floodplain habitats are similar in that seasonal high water determines which areas are flooded and for what duration. Oxbow lakes are created when segments of the previous river channel are cut off during high flow periods, which creates deep, narrow depressions that fill during flooding. When these depressions remain flooded for extended periods, almost any of the previously mentioned plant communities can occupy this habitat type.

At present, floods that produce these habitats occur only in spill years, and only when water flows exceed the channel's carrying capacity. This has been a rare occurrence over the past several decades with little formation of new oxbow lakes apparent. River channelization and lack of adequate flows are largely responsible for this result. Additionally, considerable encroachment by invasive species has been observed with large stands of saltcedar, Russian olive, cocklebur, and tall whitetop located throughout the rivers length. Most floodplain meadow habitats have either been converted to agriculture, reverted to upland shrub communities, or are in private ownership. Livestock grazing has contributed to reduced abundance of native communities.

Riverine Delta: In Great Basin systems, riverine deltas form between the river basin and terminal interface. Under natural conditions, the delta occurred throughout a transition from a single channel to a braided channel to meadow habitats. Continuous changing within braided channels resulted in a topographic variation which produced a variety of plants adapted to differing levels of water permanence. At present, this habitat type is dominated by saltgrass but also contains parishes spicebush, red goosefoot, swamp timothy, and several other freshwater adapted species. This habitat is one of the few representative examples of freshwater habitat remaining at Stillwater NWR. However, salt tolerant species, such as alkali bulrush and saltcedar are becoming more prevalent.

Encroachment by saltcedar and other nonnative species is currently spreading. As the river brings freshwater to the delta, it also bring seeds from a variety of nonnative plants. While tall whitetop has not been observed, cocklebur, prickly lettuce, and five-hook Bassia are becoming more abundant. Seed source, decreasing water input, and associated higher salinity content are slowly changing the structure of this habitat. Continuous growing season long grazing has likely added to this shift.

Riparian habitats considered in this section include a 15-mile stretch of the lower Carson River, Carson River delta, four-mile stretch of Stillwater Slough at the southern end of the existing Stillwater NWR, and a seven-mile stretch associated with the D-Line Canal through the southern end of the Stillwater WMA. Presently, none of these habitats are actively managed and the lower Carson River and D-Line Canal rely on spill years for any water input. Except possibly under Alternatives C and D, many of these habitats would remain dependent on spill-water

Alternative A: Under Alternative A, all previously described segments of riparian habitat would continue to be included in the Stillwater NWR and Stillwater WMA boundaries. Quality and availability of this habitat type would be dependent on spill-water as no water rights would be used for restoring riparian habitats on the lower Carson River and D-Line Canal. Approximately 15 miles of the lower Carson River, four miles of Stillwater Slough, and eight miles of the D-Line Canal would be retained in Stillwater WMA and Stillwater NWR. Much of this habitat is currently in private ownership. No management emphasis would be placed on riparian habitats.

Alternative B: Only the four-mile segment of Stillwater Slough and Carson River delta would be retained in this alternative. Because no active management would be placed on restoration of riparian habitats, riparian habitat along the Stillwater Slough would remain in poor condition. Furthermore, without protection and restoration efforts, river and riparian habitat along the lower Carson River and the D-Line Canal, neither of which are included in this alternative, would remain in poor condition or continue to deteriorate.

Alternative C: All previously described segments of riparian habitat, in addition to a three-mile stretch of the Carson River south of the existing Stillwater WMA boundary, would be within the Alternative C boundary. Restoration of native riparian vegetation would be enhanced by the removal of cattle grazing from riparian corridors, control of invasive species, revegetation efforts aimed at restoring cottonwoods and willows and other riparian shrubs. Other possibilities include the conveyance of water through the Stillwater Slough and D-Line Canal and acquisition of additional land and water rights, from willing sellers along the lower Carson River within the Alternative C boundary. Even if additional water is not made available for riparian restoration, the other actions identified above would enhance the composition and structure of riparian vegetation. Survival of cottonwood and willow seedlings, which have germinated along the banks of the lower Carson River during recent spill years, would be higher and these, and other native woody plants, would be higher in abundance, as compared to baseline. Over time, cottonwoods and willows would begin to replace saltcedar and Russian olive. Native grasses, such as creeping wild rye, which are now heavily grazed, would increase in composition and tall, dense stands would be produced along some portions of the lower river. Similar habitat conditions would eventually be produced along the Stillwater Slough, after intensive efforts to restore the channel are completed. To the extent that additional lands are acquired and additional water is secured for riparian habitat along the Carson River, this alternative has the potential, over the long term, to greatly enhance this habitat.

Alternative D: This alternative would result in similar riparian habitat conditions as would occur under Alternative C, except invasive species would likely comprise a larger proportion of plant community composition since herbicides, and goat and sheep herbivory would no longer be used.

4.4.1.3 Desert Shrub Plant Communities

Below is a description of the desert shrub plant communities in the study area. The shrub communities of Stillwater NWR, Stillwater WMA, and Fallon NWR are described first, followed by the shrub plant communities of Anaho Island NWR.

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Desert shrub plant communities on Stillwater NWR, Stillwater WMA, and Fallon NWR typically consist of plant species that can tolerate moderate to highly alkaline soils and can survive on minimal precipitation (about five inches per year). They are the most common vegetation type in the Lahontan Valley. The distribution of desert shrub plant communities is determined by water availability, salinity, and substrate. These three factors, in turn, are related to the topography of the landscape. Topographic depressions tend to have saline, clayey soils which pond water, where raised areas tend to have sandy, less saline, more well drained soils.

Three different upland desert shrub habitat types have been identified on Stillwater NWR, Stillwater WMA, and Fallon NWR. They are greasewood shrublands, saltbush desert shrublands, and dunes. In general greasewood shrublands occupy finer textured, more saline soils and are more frequently flooded where dune plant communities occur on course textured (sandy), well-drained soils. Saltbush shrublands occur on soils that are intermediate between those occupied by greasewood and dune communities.

Greasewood shrubland communities cover a greater area than any other plant community mapped on the three Federal wildlife areas. Fourteen different greasewood shrubland communities were identified during recent surveys (Charlet et al. 1998). While most of these communities can be found on Stillwater WMA, very few are represented on Stillwater NWR. Total cover of these communities ranges from less than 5 percent to nearly 90 percent. Most greasewood shrublands are multi-layered shrub communities, often possessing an understory of annual herbs and saltgrass. Greasewood typically dominates the overstory of these communities while other smaller shrubs, such as desert blight, shadscale, Torrey's saltbush, four-wing saltbush, catclaw horsebush, winter fat, budsage, and spotted dalea form a midstory. Historically, Indian ricegrass was more abundant in the understory of these communities. However, past grazing practices appear to have reduced the distribution and abundance of this native grass.

Saltbush desert shrubland in the study area is a low, multi-layered shrub community often accompanied by the perennial herb desert-mallow and an understory of widely scattered native annuals. Five different saltbush desert shrubland communities were identified during recent surveys (Charlet et al. 1998). This plant community is abundant at the southern end of Stillwater NWR. Saltbush desert shrublands are typically dominated by Torrey's saltbush or shadscale. Other shrubs found in this community include rabbitbrush, budsage, desert blight, catclaw horsebush, winterfat, greasewood, spotted dalea, and white burrobush.

Three different shrub communities have been identified on active dunes on Stillwater NWR, Stillwater WMA, and Fallon NWR. Two of the communities, which occur at the base of active dunes, are dominated by greasewood. Indian rice grass is abundant in both the understory and areas of open sand. A third dune plant community is dominated by the invasive species including annual herbs such as Russian-thistle and barbwire Russian-thistle. This common community appears to be spreading to many formerly bare areas and may be stabilizing some active dune surfaces, such as the tops of small dunes west of North County Road (Charlet et al. 1998).

Anaho Island NWR harbors desert shrub communities and can be characterized by dominant shrub species, such as shadscale, spiny hopsage, big greasewood, and winterfat; nonnative annual grass species red brome and cheatgrass; and native bunch grasses and forbs, such as desert needlegrass and buckwheat. Forty-eight species of flowering plants and nine species of nonflowering plants were identified on Anaho Island (Woodbury 1966 and Tauch, per. comm.) (Appendix C). Map 2.4 depicts the distribution of annual grass communities, respectively.

Anaho Island is currently undergoing a change in plant community dominance from desert shrubs and perennial bunch grasses to nonnative annual grasses. Dominant vegetation has changed in the last 30 years. In 1966, eight species of grasses were found primarily on the upper parts of the island, except saltgrass which was common along the water's edge. Shrubs dominated the vegetation of the island. In comparison, in 1998, annual grasses dominate the landscape of Anaho Island. Mature shrubs are often robust plants with phenomenal leader growth. However, shrub regeneration is very poor. Although a few stands of the native grasses on the island appear viable and healthy on the island, the majority of Anaho Island is dominated by cheatgrass and red brome. Litter accumulation of annual grasses has effectively reduced the reproduction of native desert shrubs, grasses and forbs by forming a mat of litter virtually impenetrable to native seeds thereby inhibiting seed germination. In addition, dense stands of annual grasses may out compete any native seedlings that are able to germinate for water and nutrients. Photographs taken over the years document the loss of shrubs and increasing density of annual grasses (Tausch, pers. comm.). There is a noticeable lack of native shrubs, grasses, and forbs establishing in the area.

Fire on Anaho Island would be detrimental to the native plant community. Historically, fire was an infrequent and insignificant ecological process influencing the desert shrub plant communities. Desert shrubs, bunch grasses and forbs were scattered and fuel loads were insufficient to carry a fire. In contrast, today the majority of Anaho Island is a dense layer of annual grasses and litter within the desert shrub community that would rapidly carry a fire and would thrive following a fire. If a fire were to occur on Anaho Island, the desert shrubs would most likely be replaced by annual grasses within the burned area. However, even in the absence of fire, this conversion from desert shrubs to annual grasses is progressing, although at a slower rate than if it were burned.

Under existing conditions, approximately 57,400 acres of upland habitats are divided between greasewood shrubland, saltbush desert shrubland, and sand dunes. These habitats tend to be geographically separated with saltbush desert shrublands located in the southeast corner of Stillwater NWR, sand dunes located along the northern boundary, and greasewood shrublands located throughout the refuge. Acreages for each upland habitat type are provided in Table 4.17.

Alternative A: Under this alternative, similar acreages would be provided as under existing conditions with 40,100 acres of greasewood shrubland, 8,100 acres of saltbush desert scrub, and 9,200 acres of sand dunes. With management similar to existing, livestock grazing, up to 11,000 AUM's annually, would continue throughout upland habitats. This could result in continued encroachment of cheatgrass throughout upland habitats and limit production of native species

Table 4.17. Acres of upland habitats included in alternative boundaries.

	Acres of Habitat Included within Alternative Boundaries			
Habitat Type	Alternative A	Alternative B	Alternative C	Alternative D
Greasewood Shrubland	40,100	6,300	26,500	34,600
Saltbush Desert Shrubland	8,100	8,100	8,100	8,100
Sand Dunes	9,200	6,500	10,000	11,200
Total	57,400	20,900	44,600	53,900

once common to these sites. Overall, upland habitats would remain similar, in distribution and appearance, to what exists at present.

Alternative B: With this alternative, the Stillwater WMA would no longer be managed as part of Stillwater NWR Complex, resulting in a much lower acreage of greasewood shrubland being managed by the Service as compared to baseline. Saltbush desert shrub acreage would be identical to baseline while less sand dune habitat would remain within refuge boundaries. This would result in the dune system being managed under different jurisdictions. Remaining upland habitats would have a greater level of protection from livestock grazing, with 500 to1,000 AUMs grazed annually, and only for specific management purposes. Therefore, the canopy cover of native vegetation would be higher and the spread of invasive species in these habitats would be lower. Overall, lower amounts of upland habitat acreage would be included in the boundary, but with higher levels of protection than under baseline.

Alternative C: Exclusion of the Indian Lakes area would lower acreage of greasewood shrublands; however, the boundary revision would provide for higher sand dune acreage than baseline. Livestock grazing would be eliminated throughout upland habitats allowing for regeneration of native vegetation, such as Indian rice grass. Recommendation of the northern sand dunes as a research natural area would provide for increased protection of these habitats through additional law enforcement and elimination of vehicle access. Saltbush desert shrubland acreage would remain similar to a baseline. Overall, this alternative would retain a higher sand dune, similar salt desert shrubland, and lower greasewood acreage than baselines, but would afford a higher level of protection throughout upland habitats.

Alternative D: This alternative would provide for the highest acreage of sand dune habitats (11,200 acres), with identical and slightly lower acreages of saltbush desert shrub and greasewood shrubland, respectively. Similar to Alternative C, grazing would be completely removed from upland systems and sand dunes would be additionally protected through the creation of a Research Natural Area.

4.4.1.4 Agricultural Vegetation

Irrigated agriculture generally maintains large acreages of one dominant plant species. Within an agricultural area, cultivated species, introduced species of weeds, and to a limited extent, native grasses and forbs occur. Although several hundred acres of farmland have been cultivated during the last couple of years on refuge lands, the assumption of this Draft EIS is that no farming occurs on Stillwater NWR. There are about 60,000 acres of irrigated farmland in the affected area (lower Carson and Truckee River basins).

Alternative A: Under this alternative, no agricultural vegetation would be maintained on refuge lands, as described in the WRAP EIS (USFWS 1996a).

Alternative B: Under this alternative, up to about 300 to 400 acres of agricultural vegetation would be provided on refuge lands for waterfowl forage. Alfalfa and grain crops (barley, oats, wheat) would be the primary crops.

Alternative C: Similar to Alternative B, 200 to 300 acres of agricultural vegetation would be provided for waterfowl under this alternative.

Alternative D: This alternative would entail no change from Alternative A, as no farmland would be cultivated for waterfowl.

4.4.1.5 Native Community Abundance

Under existing conditions, approximately 194 plant species have been identified in the Lahontan Valley; more than 70 of which are currently listed as nonnative. Most, if not all, of these have been documented on Stillwater NWR, Stillwater WMA, and Fallon NWR, or are thought to occur on these areas. Nonnative species have been introduced to the Lahontan Valley for a variety of reasons and causes. Unstable water availability, increased salinity of inflows, and livestock grazing practices have likely contributed to their spread throughout the Stillwater NWR Complex, by reducing vigor and survival of native vegetation. Most of these species are annual weeds which rely on seasonal, usually spring, water pulses to grow and set seed; however, tree and tall shrub species, such as saltcedar, Russian olive, and Siberian elm and grass species, such as cheatgrass, have encroached on native habitats as well. Irrigation of agricultural fields, reduced inflow, fluctuation of marsh habitats, continuous growing-season-long cattle grazing, and increased water and soil salinity levels have all contributed to their increased presence among marsh and riparian habitats.

Most of the nonnative species are generalists, which means that they can survive in a variety of habitats in the Stillwater area, but they also form plant communities. Some species have become so abundant that they are the most common members of some plant communities. Of 38 described plant communities for Stillwater NWR, Stillwater WMA, and Fallon NWR, seven are considered nonnative-dominated, such as saltcedar, Russian olive, five-hook Bassia, and these contribute to a large percentage of wetland acreage.

Most native communities have at least some representation by nonnative plants. The boundary revision effort could have some effect on the representation of native communities within refuge borders, as many communities are currently only found at sites that would not be retained under some alternatives. Aside from different boundaries, the main differences between alternatives on

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the survival and perpetuation of native plant communities are water delivery schedules to Stillwater Marsh, potential for acquiring additional water for the lower Carson River, livestock grazing practices, and practices for controlling invasive species.

While most native species are still present in the Lahontan Valley, at least to some extent, they no longer exist in sufficient quantities to constitute a plant community. Some of the missing native communities and/or species include:

Basin-Wetland
  Pickelweed
  Northern Arrowhead
  Long-leaved pondweed
  mixed meadow grass
  water hyssop
  Parish's spike rush

Riparian-Wetland
  Cottonwood/Great Basin wild rye
  Cottonwood/Willow
  Cottonwood/mixed deciduous shrub
  Buffaloberry

Upland
  Indian rice grass

Alternative A: With the completion of the water rights acquisition program, more freshwater would enter the system which would provide conditions suitable for many native plants. Some native communities, such as the arrowweed, coontail, and long-leaved pondweed plant communities, are no longer present in the Stillwater Marsh. It is thought that freshwater added to the marsh would provide conditions suitable for their reestablishment. Less water level fluctuation would occur under this alternative, which would reduce the amount of wetland-habitat available for growth of nonnative, annual weed dominated communities, such as five-hook Bassia, prickly lettuce, strawberry clover, and saltcedar. However, this same reduction in water level fluctuations could deter reestablishment of wet meadow native communities, such as mixed meadow grasses, water hyssop, and Parish's spicebush.

Riparian corridors would continue to be flooded only during spill periods which, in conjunction with continued livestock grazing, would deter restoration of native tree, shrub, and grass species. Similar results would occur for Indian ricegrass in upland habitats. Overall, freshwater would aid in the restoration of freshwater associated wetland communities but lack of natural water level fluctuations would not help native communities associated with these fluctuations under this alternative. Riparian and upland communities would remain largely unchanged from existing.

Alternative B: This alternative would focus on providing fall and winter habitat for waterfowl, thus, summer drawdown and fall flooding would be the primary water-management objectives. Similar to baseline, more freshwater would enter the system which would increase habitat availability for many native species over existing conditions. However, summer drawdown would again provide suitable habitat for nonnative annual weeds and without spring water to flush salt from the system, many of these drawdown habitats would still facilitate nonnative vegetation growth.

Of the major riparian habitats only Stillwater Slough would remain within the refuge boundary under this alternative. While riparian restoration efforts, such as artificial plantings of native trees and shrubs, would be practiced, only four miles of this habitat would be available. Indian rice grass would benefit from reduced levels of livestock grazing in uplands; however, little habitat available for its regeneration would remain within refuge boundaries. Overall, increased freshwater inputs would increase freshwater habitat quality from existing conditions. Even so, native community abundance would likely be lower than baseline under this alternative. Restoration of riparian and upland habitats would produce higher quality, but less available habitat than existing.

Alternative C: Through simulation of the natural hydrology, considerable amount of freshwater would enter the system which would likely benefit efforts to restore native communities. These spring floods, along with the reduction in livestock grazing, would provide conditions suitable for the survival of a mixed meadow grass community within wet meadow habitat. While summer drawdown would still occur under this alternative, spring floods would reduce salinity in marsh habitats, which would lower salinity on mudflats where nonnative annual weeds have become more prevalent. This could result in a shift from five-hook Bassia and prickly lettuce to native devils beggartick, smartweed, and wild millet within moist-soil habitats. Fall water management would promote equal percentages of drawdown, stable water, and flooded habitat which would provide a mix of habitats, from those representative of native communities to those with a high composition of nonnative species. While this would not necessarily follow the natural hydrology, it would occur very late or after the growing season, on habitats where salinity levels had already been reduced through spring flooding.

In riparian areas, and over the long term, native plant communities with limited distribution would return as a consequence of eliminating cattle grazing along the lower Carson River and Stillwater Slough, aggressive control of saltcedar and noxious weeds, and especially securing additional water for the lower Carson River. Eliminating cattle grazing from upland areas would assist in preventing cheatgrass from further expansion into greasewood, other desert shrub communities, and dunes. However, even under this alternative, without efforts to address the cheatgrass problem, some of these upland plant communities could convert into annual cheatgrass communities, and some upland communities may be lost. Overall, this alternative would likely provide the best conditions for restoring native communities and reducing the extent of nonnative species coverage.

Alternative D: Similar to Alternative C, this alternative would promote native community growth in spring flooded habitats and reduce mudflat salinity during evaporative summer drawdowns. This would simulate a natural ecological process which should provide the best conditions for restoring a natural mix of marsh vegetation. It is unknown what the effects on marsh vegetation would be from attempting a full simulation of natural flow patterns with an estimated 15 to 20 percent of the average historic water. Therefore, spring and summer habitat conditions would be optimal for restoration of native community abundance. However, the effects of artificially low water levels during fall are unknown. Riparian and upland native community response would be similar to Alternative C, except that restoration of native riparian communities would be more limited under Alternative D.

4.4.1.6 Invasive Plant Species

Under existing conditions, ten species of invasive plants are currently found throughout the affected area, three of which require immediate attention (saltcedar, Russian olive, and tall whitetop; Table 4.18). Additionally, purple loosestrife has been observed on the Truckee canal which often provides additional water rights to nearby Lahontan Reservoir. Russian olive does not appear to be spreading at present. Under existing conditions, tall whitetop is sporadically distributed at low densities. Control of all of these species and other potential invasive species will be covered in the station's integrated pest management plan.

Alternative A: The primary management techniques to control invasive plants under this alternative would include water-level management, mechanical treatments, chemical treatments and biological control techniques. While this alternative would not identify specific target areas on an annual basis, spot control of problem concentrations would still be practiced. Enhanced water-level control through increased water rights and management for less fluctuating water levels would tend to reduce shoreline saltcedar concentrations by flooding out existing communities. Therefore, even without active control, saltcedar distribution would, in the long term, be lower under this alternative than the others.

Alternative B: The level of control under this alternative would be similar to baseline except that summer drawdowns would be conducive to saltcedar germination, and could result in higher amounts of saltcedar acreage. Active management would focus on specific locations with control techniques often used opportunistically. Overall, this alternative would provide for a lower level of control than baseline as evaporative summer drawdowns could promote saltcedar growth. All available management tools could be used.

Alternative C: Invasive plant control would be emphasized under this alternative, considering the increased focus on management for natural biodiversity. Water level management, especially evaporative summer drawdowns, would promote saltcedar growth. However, specific communities, identified in a habitat management plan to be developed, would be annually targeted for control. Water level management between years (with one-third fall flooding, one-third stable, and one-third drawing down) would allow for rotation of saltcedar flooding strategies, while drawdown units could be targeted for active control techniques. Active invasive species control would be used along the Carson River riparian corridor, with different segments targeted annually. There would be a decreased reliance on chemical treatments under this

Table 4.18. Invasive Plant Species that Occur on the Stillwater NWR Complex and Vicinity.

		Noxious Weed Lists		
Common Name	Scientific Name	Federal	State	Distribution
Saltcedar	*Tamarix ramosissima*	no	no	Primarily distributed along water delivery canals, the periphery of wetlands, and the Carson River and delta, Anaho Island
Perennial pepperweed	*Lepidium latifolium*	no	yes	Isolated spots within refuge and along the lower Carson River
Russian olive	*Elaeagnus angustifolia*	no	no	
Purple loosestrife	*Lythrum salicaria*	no	no	Lower Truckee River
Red brome	*Bromus madritensis* spp. *rubens*	no	no	Anaho Island,
Cheatgrass	*Bromus tectorum*	no	no	Anaho Island,
Russian thistle	*Salsola tragus*	no	no	Dunes
Diffuse knapweed	*Centaurea diffusa*	no	yes	Recently acquired agric. lands
Russian knapweed	*Centaurea repens*	no	yes	Recently acquired agric. lands
Hoary cress	*Cardaria draba*	no	yes	Recently acquired agric. lands

alternative with the understanding that some level of chemical control would be required during early stages of control. All identified species would be considered in annual habitat management plans. Overall, this alternative would provide a higher level of active control over baseline. Passive control, such as providing stable water levels between shoreline habitats, would be lower than baseline.

Alternative D: Full simulation of natural hydrologic process would provide natural spring flooding and scouring processes which would either directly flood or uproot invasive species where scouring occurs. However, summer evaporative drawdown (conducive to saltcedar growth) and lack of fall flooding would provide for higher annual germination rates than under baseline. Similar to Alternative C, active invasive species control would be practiced annually along the Carson River riparian corridor and marsh shoreline habitats; however, there would be a lower reliance on active management techniques, such as chemical and mechanical treatments. This alternative would allow natural processes to function, assuming that they will reduce invasive species distribution and increase native vegetation acreages over existing conditions. It would take time to determine whether these processes are completing this task and monitoring protocol would be implemented to ensure that this goal is being met. Overall, the level of invasive species control would be lower than baseline under the assumption that natural processes will provide control.

4.4.1.7 Public-Use Impacts on Vegetation

Public-use management strategies identified for each alternative would have varying effects on vegetation community distribution, composition, and structure. These effects would include direct impacts (for example vegetation trampling (Liddle and Scorgie 1980) and introduction and/or spread of invasive species (Lonsdale and Lane 1993)) and indirect impacts (for example, changes in community composition, height, and density in areas of high use over time; Liddle 1975, Liddle and Scorgie 1980). Some habitats, such as most wetland areas, change rapidly regardless of human intrusion while upland habitats require many years to reach maturity and are thus, less tolerant of human caused disturbance. For example, cryptogammic soils in some upland areas require hundreds of years to form and would likely be an irretrievable loss if public-use activities were allowed on these sites.

Several public-use activities were evaluated in relation to vegetation responses including hunting, fishing, hiking, boating, camping, and off-road vehicle use (Appendix L). Effects include creation of unvegetated zones on heavily used trails, total removal or decreased coverage of vegetation in isolated areas from boat propellers and vehicle travel, soil compaction and resulting inhibition of seedling emergence, long-term changes in vegetative community plant composition, and providing disturbed soils that are more favorable for the establishment of invasive species. Timing of public-use activities is critical because any activity during the growing season will have more impact than when plants are dormant (Liddle and Scorgie 1980). However, cumulative impacts from long-term use, growing season or not, can result in vegetative community changes over time. Other potential impacts in upland habitats includes introduction and spread of nonnative plants from vehicles and horses. Similar adverse impacts can result from management (e.g., road maintenance) and research activities.

Although most public-use impacts on native vegetation are adverse, albeit slight in most cases, some activities would be specifically designed to benefit native vegetation. Some groups have been actively involved in riparian restoration at the refuge, combining efforts to reestablish native willow and cottonwood with environmental education and wildlife observation. In some instances, hunter foot travel through the marsh can create minor openings in emergent habitat. Soil disturbance related to this activity can bring seeds to the surface which allows them to grow during the next low water period. Additionally, low levels of boat use can aid in distribution of submergent vegetation by spreading seeds to previously uncolonized areas (Liddle and Scorgie 1980). These types of impacts are analyzed in the following discussion.

Alternative A: Under this alternative, all wildlife-dependent recreational activities (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) and all other existing uses (camping, boating, horseback riding) would continue. Habitat would be subject to all of the previously described detrimental and beneficial impacts. Environmental education would continue to increase which would allow an opportunity to educate the public about use effects on vegetation. Similar to slightly higher levels of public use than existing would occur which would result in slight to moderate impacts to native vegetation; however, these impacts would be noticeable only in isolated areas where high levels of human activity were allowed. Sand dune habitats would remain open to public use but would have no additional access roads developed or maintained. However, limited unauthorized off-road vehicle use would continue to have localized adverse impacts (e.g., soil compaction, nonnative-vegetation seed dispersal) on native vegetation in dune areas. Overall, this alternative would result in little vegetative change from existing conditions, with some additional protection afforded through environmental education.

Alternative B: This alternative would be similar to alternative A with a few exceptions. First, a full time law enforcement officer would be hired to ensure that vehicles remain on roadways and other applicable rules and regulations are adhered to. Second, there would be a complete closure of refuge habitats to public uses from April 1 to July 31 which would protect aquatic and upland vegetation from public-use impacts throughout the growing season. Additionally, motorized boat use would be eliminated from August 1 - the beginning of waterfowl season which would provide protection for emergent and submergent plant communities toward the end of the growing season. While sand dunes within refuge boundaries would remain under Service protection and increased law enforcement, part of the sand dune system that is now under Service administration would no longer receive this level of protection. This could result in additional impacts to native vegetation and increases in the occurrence of invasive species in these dunes. Overall, this alternative would provide slightly higher vegetation protection from public-use activities on lands retained in the Refuge System as compared to baseline, but much less habitat, particulary upland, riparian, and sand dune systems would be protected by the Service.

Alternative C: Two different public-use management options are being considered under this alternative with anticipated equal effects on Stillwater NWR complex vegetation. Under Option 1 of Alternative C, two additional wetland units would be maintained as inviolate sanctuary, thus, protecting sensitive plants and habitats in this area. Part of the area now within the sanctuary would be opened to public use, this could result in additional impacts to vegetation due to wildlife observation, photography, and other activities. However, these activities would be conducted only on designated trails, pullouts, and roadways. The new trails created under this alternative could impact vegetation communities in localized areas. Concentrating use along designated trails would reduce adverse impacts in other areas of the refuge. All trails and roads would be designed to minimize impacts to vegetation. Access to riparian areas and the Carson River delta would be closed south of Timber Lake which would eliminate public-use related impacts in this area. The sand dunes at the northern edge of the refuge, including dunes that are now outside the refuge boundary, would be retained as a research natural area allowing vegetation establishment processes to function without human disturbance.

Under both options, watercraft would not be allowed anywhere on the refuge from March 1 to August 1 with the exception that one or two canoe trails would be established in Goose Lake. These trails would be designed such that vegetative disturbance would be at a minimum. Additionally, boats would be limited to no wake and, in Option 1, would not be allowed on Goose Lake, which would help protect emergent and submergent communities throughout wetland habitats. Vehicle travel would be maintained on established roadways only, with seasonal road closures provided in certain areas. An environmental education center would be established on either the former Weishaupt or former Kent property. This would increase disturbance on habitats adjacent to center trails but could reduce impacts to core wetland habitats by reducing the public-use burden and associated vegetation impacts currently associated with these areas. Overall, both options would result in similar public-use impacts as would occur under Alternative A; however, a different set of disturbance effects would be anticipated.

Alternative D: Public-use impacts on vegetation under this alternative would be similar to Option 1 of Alternative C with the following exceptions. The Carson River delta and the western edge of the sand dunes would be interpreted and subject to slight, localized hiking impacts. No less than 40 percent of wetland habitat would remain as inviolate sanctuary providing complete protection of this area. The remaining 60 percent would be split between hunting and other public uses maintaining slight vegetation disturbance through hiking and boating. With development of observation areas, trampling effects would be increased in these locations, but this would likely reduce public-use impacts throughout refuge habitats. Overall, this alternative would localize disturbance effects over all other alternatives but would increase the severity of impacts at specific locations.

4.4.2 Wildlife

The following section describes the baseline status of all wildlife groups and potential impacts of each alternative on various parameters. This section covers birds, mammals, reptiles, amphibians, fish, and invertebrates. Discussions of impacts address the effects of changing the boundary of Stillwater NWR, implementation of alternative management strategies, other habitat alterations such as the spread of invasive species and impacts to water quality, and the effects of public-use activities on wildlife.

The major factors currently limiting wetland wildlife diversity is an inadequate supply and altered timing of water, and the presence and spread of nonnative species (including saltcedar, carp, bullfrogs, and cattle), as discussed in Appendix N. Contaminants also have the potential to impact wildlife diversity. Effects of changing Stillwater NWR's boundary would affect wildlife primarily through differences in the level of protection and restoration potential. Although some management strategies can affect wildlife populations directly (e.g., muskrat trapping, predator control, mosquito control), most refuge management activities are geared to habitat management, and therefore, most of the discussion in this section focuses on the effects of changes in management on wildlife habitat. Except where noted, the action alternatives would have no significant adverse impacts to wildlife populations or communities, and therefore, no mitigation measures would be needed.

Recreational use and public use management also affect wildlife and their habitat. For example, providing opportunities for hunting, birdwatching, and other wildlife-dependent public uses on Stillwater NWR in the past ultimately contributed to more water flowing into the refuge because, if it were not for the support of people using Stillwater NWR and other Lahontan Valley wetland areas for wildlife-dependent recreation, it is unlikely that the Service would be acquiring needed water rights for refuge wetlands. Another way that people affect wildlife happens while people are engaged in a recreational activity in wildlife habitat (this can also be said of refuge personnel while they are working on the refuge). This aspect of public use, which is referred to as human disturbance, is evaluated because the Service is responsible for ensuring that all public uses are compatible with (i.e., do not detract from) the achievement of refuge purposes. The effects of human activity are treated extensively in this Draft EIS due to Service requirements to evaluated the compatibility of public uses before they are permitted and because of the high level of interest by the public on this issue.

4.4.2.1 Birds

Most bird populations at the Stillwater NWR Complex are migratory and, thus, the various habitats have different levels of importance to different species depending on which seasons they inhabit the area and the reasons they are using the area's resources. For example, waterfowl species, such as mallards and Canada geese can be observed year-round, if wetland-habitat does not freeze completely, using wetland-habitats for breeding, spring and fall migration, molt, winter maintenance, and a variety of other reasons. Species such as Tundra swans are typically only here for migration and winter maintenance. Furthermore, these species have different seasonal habitat requirements and, between species, different habitat needs. Using breeding habitat as an example, dabbling ducks, such as mallards, require uplands adjacent to wetland-habitats while diving ducks, such as redheads and canvasbacks, require deep emergent vegetation to build their nests. Where information is available, these factors will be considered.

Migratory birds using Stillwater NWR Complex wetland-habitats are part of continental populations which may fluctuate widely given conditions in other regions of the country. Many shorebird species nest in other locations and only migrate through the Stillwater area. If these birds experience poor habitat conditions in their nesting areas or suffer disease losses at traditional wintering areas, fewer birds may migrate through the Stillwater NWR Complex, even though local habitat conditions may be optimal for their use. This concept must be considered when reading the following sections, as the assessment of impacts for each alternative assumes that off-refuge conditions are the same between alternatives and, for wetland-habitats, that habitat acreage is directly linked to the number of birds using the wetlands in a given year. This assumption was made so that gross differences between alternatives could be portrayed.

As in discussions of possible effects on habitat, the following assessment focuses on potential impacts during nonspill years. Existing conditions assume that a long-term average of 6,600 acres of wetland-habitat can be maintained during nonspill years given the volume of water rights that have been acquired thus far. It is assumed that the same relative differences in effects between alternatives may be apparent during spill years, but many of the effects of any given alternative would be outweighed by the volume of spill-water entering the wetlands. Timing and volume would be nearly identical between alternatives. Generally, spill years would be highly beneficial to wetland birds.

4.4.2.1.1 Waterfowl

The Lahontan Valley wetlands offer the most important and productive waterfowl habitat in the affected area. In many years, up to 70 percent of the Nevada's migratory waterfowl pass through and feed in these wetlands (N. Saake, State Waterfowl Biologist, NDOW, oral communication, 1993). Peak populations of migrating waterfowl are generally recorded in the fall. The major species of ducks that use the wetlands during migration are northern pintails, mallard, gadwalls, green-winged teal, northern shovelers, American widgeon, canvasbacks, ruddy ducks, and redheads. Canada geese, snow geese, tundra swans, and small numbers of trumpeter swans migrate through the affected area as well. Peak population levels of most of these species occur during the fall, with several exceptions including ruddy ducks (spring), geese, and swans (winter) (Bundy 2000).

Waterfowl use at Pyramid Lake is greatest during fall and winter. Pyramid Lake also becomes important waterfowl habitat in drought years when other nearby wetlands are dry. The northern end of Pyramid Lake, which provides shallow feeding areas and receives less disturbance from recreationists, and the southern end near the mouth of the Truckee River, are the most important feeding areas for waterfowl. Up to five pairs of Canada geese have nested on Anaho island NWR in the recent past (Stillwater NWR files).

Under existing conditions, waterfowl occupy wetland-habitats of Stillwater NWR, Stillwater WMA, and Fallon NWR during all times of the year except when the area completely freezes over. Several different populations use the wetlands with distinct breeding populations (many of which migrate from the area during early fall) often followed by migratory populations that have completed breeding in more northern areas. As a result, when these two populations occur together on the wetlands during early fall, under existing conditions, waterfowl populations of the Stillwater NWR complex in nonspill years would typically peak at approximately 100,000 to 150,000 total waterfowl in October (Figure 4.1). In spill years, waterfowl populations can peak at 250,000 total waterfowl during the fall. Spring migration is generally the second highest use period while breeding populations are considerably lower. Although breeding populations are relatively low compared to migratory populations, approximately 3,000 to 5,000 ducklings and goslings are produced in the Stillwater NWR in any given year.

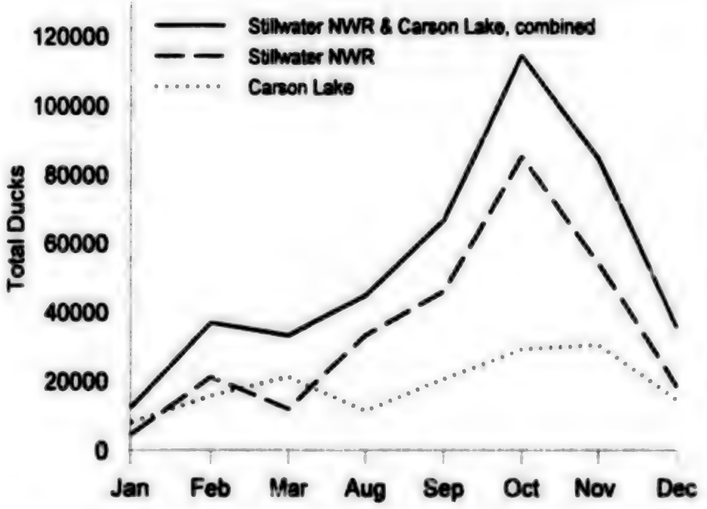

Figure 4.1. **Average number of ducks counted on Stillwater National Wildlife Refuge, Carson Lake, and both areas combined during Nevada Division of Wildlife waterfowl surveys conducted during the period August-March, 1970-1998. (Bundy 2000)**

Waterfowl production rates are highly dependent on the amount and type of wetland-habitat acreage available and quality (measured in composition and structure of grass species) of upland nesting habitat during the spring and summer. Most available nesting habitat currently exists along delivery canals with little upland habitat in suitable condition for waterfowl nesting. Livestock grazing is one factor that has contributed to this condition. Nest concentration along these canals provides predators with easy access to large numbers of nests.

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Results of a 1997 monitoring effort along canals show that nest success ranged from 24 percent (cinnamon teal) down to 3 percent (mallards; Bundy and Henry 1997). Other refuge nesting studies are consistent with this result (Marshall 1952, Napier 1974, Evans 1983, Bowman 1989).

All marsh habitats are used depending on the seasonal requirements of a given species. During summer, most species require a mix of deep emergent and submergent vegetation habitats to provide protection and foraging habitats for waterfowl broods. An even mix of these two habitat types provides optimal conditions for brood survival (Weller and Spatcher 1965). Diving ducks, such as redheads, canvasbacks, and ruddy ducks, nest in deep emergent habitat while dabbling ducks nest in adjacent uplands. Under existing conditions, approximately 25 to 55 percent (1,650 to 3630 acres) of the wetland-habitat would be comprised of deep emergent and submergent habitats during summer months. This would accommodate production of 3,000 to 5,000 ducklings annually.

Following breeding, waterfowl species enter a flightless stage (known as molt) where they replace the previous years flight feathers with new feathers for the upcoming fall migration. During molt waterfowl are most vulnerable and prefer deep emergent habitats where they can hide from potential predators. Marsh habitats typically used include submergent and deep emergent habitat types. Submergent vegetation provides feeding habitat while deep emergent vegetation provides cover from predators. Under existing conditions, an estimated 1,650 to 4,620 acres of these habitats would be available for waterfowl molting use.

During fall migration, an estimated 100,000 to 150,000 waterfowl would use wetland-habitat on Stillwater NWR under existing conditions. Similar to breeding requirements, most species use submergent and deep emergent habitats for foraging, protection, and resting; however, other habitats become equally important during this period. Many dabbling ducks, including green-winged teal, pintail, mallards, gadwall, and wigeon, prefer to feed in moist-soil, wet meadow, and other shallow water habitats where plant seeds are abundant (Kadlec and Smith 1989). Water depths between 1 and 12 inches are optimal for these species (Fredrickson and Taylor 1982). Under existing conditions, an estimated 600 to 4,000 acres of these habitats would be provided.

Winter maintenance habitat is similar to fall migration habitat for many species; however, shallow emergent vegetation is important for tundra swans and snow geese while agricultural lands provide grain and green forage for Canada geese and mallards. Alkali bulrush, the primary component of shallow emergent vegetation, produces underground roots (tubers) which tundra swans and snow geese prefer to eat. Under existing conditions, an estimated 660 to 2,310 acres of this habitat type would be available during late fall and winter months.

To complete the cycle, nearly all marsh habitats are used by all waterfowl species for spring migration. During spring, most waterfowl species eat invertebrates to gain protein for upcoming breeding and molting periods (Swanson et al. 1979). Invertebrates are found in all wetland-habitats, with invertebrate community composition and abundance dependent on habitat type (Bundy 1996). Habitats providing this resource vary from year to year, but all wetland-habitats (approximately 6,600 acres) would be used during spring migration. Overall, an estimated eight-

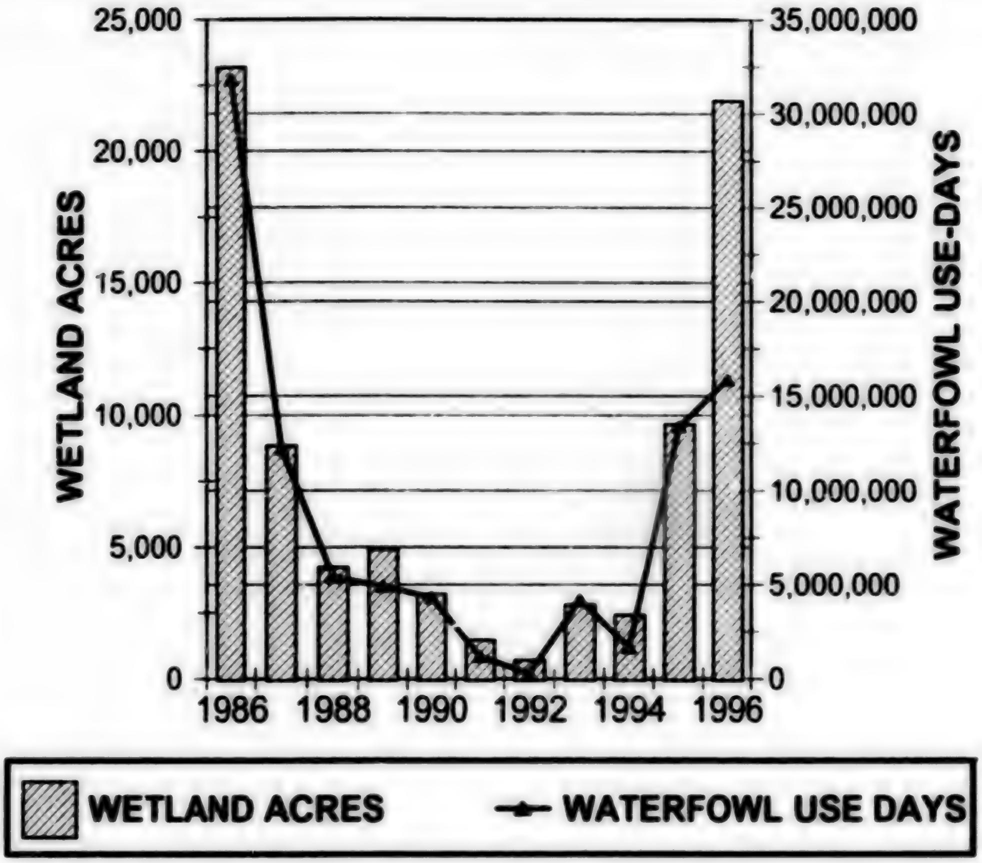

Figure 4.2 Comparison of wetland-habitat acres and waterfowl numbers on Stillwater NWR.

to ten-million waterfowl use days would be supported annually at the Stillwater NWR under existing conditions during nonspill years. After consecutive spill years, Stillwater NWR and Fallon NWR have supported up to 30 million waterfowl use days (1986 estimates). Waterfowl use-days in relation to existing available wetland-habitat are included in Figure 4.2.

It would be difficult to provide an exact number of waterfowl use-days that would occur under each alternative. However, based on our knowledge of monthly waterfowl use at Stillwater NWR over the last 30 years (Bundy 2000) and our understanding of waterfowl life history requirements, it is possible to estimate, within a range, waterfowl use as indexed by waterfowl use-days. Considering annual variation in waterfowl fall flights, weather, and other factors such as disease die-offs at migration and wintering areas, waterfowl use-days were used as an index of the number of birds Stillwater NWR habitats could potentially support under each alternative. Therefore, waterfowl use-days, in this discussion, are used to compare differences among alternatives, are based on what Stillwater NWR wetland habitats could potentially support, and should not be interpreted as estimates of the number of waterfowl projected to occur under each alternative.

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Components of the Service's public-use program could, depending on how it is designed and managed, affect the number, distribution, and duration that waterfowl species remain on refuge wetland-habitats. A review of the scientific information was undertaking to gain a better understanding of the effects human activity on waterfowl and other wildlife (Appedix L). The following discussion assumes baseline wetland-habitat acreage in a nonspill year. Besides direct impacts associated with waterfowl hunting (such as harvest), indirect impacts also occur. For example, hunters influence the distribution of waterfowl (Appendix E), which generally use nonhunted habitats during the day (including portions of units open to hunting that hunters are not using) while foraging at night to gain much of their required energy for migration. It is not certain whether this is solely related to hunting pressure, or more likely, a combination of public-use pressure and behavioral traits of the birds. However, studies summarized in Appendix L have shown that hunting and other public-use activities can influence the distribution and feeding patterns of waterfowl.

Although wildlife observation and general visitation of Stillwater NWR, Stillwater WMA, and Fallon NWR currently is at a relatively low level, there are no mechanisms in place to prevent or minimize adverse impacts to breeding waterfowl and other waterbirds, except for the sanctuary on Stillwater NWR. The breeding season is one of the most critical life-history stages of waterfowl using Stillwater NWR, the timing of which corresponds with peaks in visitation for wildlife observation. Outside the sanctuary, people are free to walk around and boat wherever they please. Applicable impact categories described by Purdy et al. (1987; see Section 4.4.2) include numbers 3, and possibly 4, 5, and 6 if public use is high enough at any given time in a particular habitat. Vehicle traffic is a source of direct and indirect mortality (categories 1 and 2). Environmental education and interpretation activities can contribute further to the effects listed above, but the impacts of these activities are likely at a more localized and limited extent. Considerable energy must be obtained for successful nesting. Nesting attempts can potentially be impacted by wildlife-dependent activities that occur during this time. These impacts range from distributional changes related to increased waterfowl/public contact, to direct effects related to habitat degradation and/or nest abandonment.

The timing of hunting (fall/early winter) places this activity at a time when waterfowl are maintaining body weight for upcoming events, a time period that is less critical than the breeding season. However, hunting has the added impacts of direct and indirect mortality of waterfowl (Purdy's impact categories 1 and 2). In recognition that hunting has been identified as a priority public use of the Refuge System when shown to be compatible, this adverse impact to waterfowl using the refuge is viewed as an acceptable impact to the extent it does not result in measurably reduced abundance of any waterfowl species on the refuge.

As with other uses, there are few restrictions on hunting on Stillwater NWR beyond State-published waterfowl regulations. Up to 72 percent of wetland-habitats have been hunted (no maximum amount has been set), no restrictions on hunter numbers or densities; airboats and other boats are allowed throughout the marsh with few restrictions; one to three boat landings per wetland unit; all-day hunting, seven days per week; and roads encircle most wetland units. Not only is the sanctuary area of the Stillwater NWR Complex relatively small (in the Western United States, the average amount of wetland-habitat in sanctuary on national wildlife refuges is

55 percent, but most wetland refuges have at least 60 percent in sanctuary), it also is of lesser quality than that of other wetlands in Stillwater NWR. Nearly half of the sanctuary is comprised of a wetland unit that primarily acts as a regulating reservoir. Therefore, there are few mechanisms in place to prevent or minimize adverse impacts summarized in Appendix L. Of most concern are the effects of boating, density of hunters, and the apparent inadequacy of the refuge's existing sanctuary, relative to the new purposes of the refuge.

Alternative A: Completion of the water-rights acquisition program and an associated wetland-habitat acreage increase in Stillwater Marsh (an estimated average of 12,500 acres during nonspill years) would provide habitat to support approximately 15 to 20 million waterfowl use-days, with peak populations occurring during fall migration. Additionally, an estimated 5,000 to 10,000 ducklings and goslings would be produced, up to twice as high as duck production estimated for existing conditions. Water management under this alternative would result in little fluctuation in water levels, which would be optimal for breeding waterfowl. However, this management strategy would be less likely to produce ideal feeding habitat for fall migratory and wintering dabbling ducks. The proportion of moist-soil, shallow emergent, and wet meadow habitat to be drawn down in summer (producing conditions favorable to fall migratory waterfowl) would decline from existing conditions, but the overall acreage of this habitat would increase. Spring migration habitat would average about 13,500 acres and would provide a moderate diversity and density of invertebrates.

Public-use management would continue as it has in the past with sanctuary provided south of Division Road only. All wetland units open to public use (about 60 to 70 percent under baseline conditions) would be subject to direct and indirect adverse impacts associated with boating and other activities during the hunting season. Boating would continue to occur throughout the majority of the available wetland-habitat, which would affect waterfowl even at low hunter densities. This may be one reason why waterfowl habitat use and distribution has shifted during the hunting season over the past several years (Appendix E) even when hunter density was relatively low. Effects would include alterations in waterfowl species' distributions and habitat use, vegetation trampling, nest abandonment, changes in feeding patterns, effects on the amount of time available for feeding, and possibly even altered nutritional status or premature departure from the area (Appendix L). To the extent that fishing pressure would increase with more consistent wetland-habitat and enhanced fisheries, nesting waterbirds would be adversely impacted. While it is unclear whether the level of disturbance has exceeded a tolerable threshold during the past few years, when wetland-habitat acreage has been exceptionally high and public-use levels were relatively low, it is anticipated that public-use densities would increase with a more reliable wetland-habitat acreage base, increased demands for wildlife-dependent recreation, and a growing urban population. These factors, combined with few limitations placed on public use under the existing program, could limit the Service's ability to provide secure places for waterfowl to nest, feed, rest, and escape inclement weather and to otherwise provide for the seasonal needs of waterfowl species.

Alternative B: This alternative was developed to benefit fall migratory and wintering waterfowl and, therefore, peak waterfowl populations would increase beyond those anticipated for Alternative A. Drawdown management during summer months would provide ideal conditions for the development of unvegetated, alkali mudflats for late summer and fall staging waterfowl and moist-soil, shallow emergent, and wet meadow habitats for migratory and wintering populations. Annually producing 300 to 400 acres of grains and green forage in the farmland area of Stillwater NWR would further benefit Canada geese. There would be more spring migration habitat available under Alternative B (an estimated average 11,100 to 13,500 acres in nonspill years) with a moderately higher diversity and density of invertebrates resulting from higher habitat diversity (higher proportion of flooded moist-soil, shallow emergent, and wet meadow vegetation), as compared to Alternative A.

There would also be more breeding habitat available to waterfowl under this alternative, as compared to Alternative A. A predator control program would further enhance nesting success of waterfowl. An estimated 5,000 to15,000 ducklings and goslings could be produced during nonspill years under this alternative upon completion of the water-rights acquisition program. Summer drawdown would decrease the amount of brooding habitat, but a sufficient amount should be available to accommodate broods. Waterfowl use-days could increase to 20 to 25 million, primarily resulting from an increase in the amount and quality of fall and winter wetland-habitat, as compared to baseline.

Similar to Alternative A, up to 60 or more percent of refuge wetland-habitat would be open to public use, resulting in similar impacts identified above. All wetland areas would be closed to foot traffic and boat use from March 1 to August 1, minimizing impacts on breeding waterfowl, while fishing would be prohibited throughout the refuge, thus minimizing disturbance and vegetation trampling associated with this activity. Considering the emphasis on maximizing fall habitat, it is possible that hunter and other public user group densities could be lower than under Alternative A, although substantially higher consistency in providing large acreages of wetland-habitat during the hunting season would attract additional hunters. Although impacts from boating would be reduced under this alternative, waterfowl would continue to be affected by boats accessing a large majority of wetland habitats during the fall and winter. Because this alternative has few provisions to ensure that waterfowl and other waterbirds would not be adversely affected by boating and other activities beyond an acceptable level, further restrictions may be necessary in the future. It is possible that higher waterbird populations associated with increased fall habitat could result in food in the sanctuary being depleted earlier in the season. This could result in increased waterfowl use at night in areas that are open to public use during the day.

Alternative C: Under this alternative, peak populations during nonspill years would be similar to or slightly higher than Alternative A, and moderately lower than those anticipated for Alternative B. In general, the higher amounts of water-level fluctuations that would occur under this alternative would tend to enhance marsh productivity and therefore would benefit waterfowl, as compared to baseline. The quality of fall and winter habitat would be higher than under baseline, but there would be less overall acreage available for fall migratory and wintering populations. Fall and winter wetland-habitat available for waterfowl would increase by an estimated 54 percent over existing conditions, as compared to an 87 percent increase under Alternative A. Annually producing 200 to 300 acres of grains and green forage in the farmland area of Stillwater NWR would further benefit migrating and wintering Canada geese. The higher amount of wetland-habitat that would exist during the breeding season (estimated 36 percent more than under baseline) would greatly enhance waterfowl nesting. The spring pulse of water would be timed to minimize nest flooding. An estimated 10,000 to 15,000 ducklings and goslings or more would be produced, related to more habitat available for nesting and brood-rearing. To the extent that even a small amount of water is secured for the lower Carson River and the riparian corridor is restored, wood ducks would benefit and waterfowl nesting in the wetlands at the delta of the Carson River would be slightly enhanced, due to a small amount of water reaching the delta. Increased water supplies to the lower river, combined with removal of cattle and control of saltcedar and perennial pepperweed would enhance waterfowl nesting habitat in this area. Overall waterfowl use-days would be similar to Alternative A, based on the relatively higher amounts of preferred fall-migration and winter-maintenance habitat and changes in public use management (especially boating restrictions and reduction in the amount of area affected by boats) even though overall wetland-habitat acreage during fall and winter would be less than Alternative A.

Two public-use options are being considered under this alternative. Option 1 of Alternative C would increase the proportion of wetland-habitat closed to hunting, with additional sanctuary units located in the historic Stillwater Marsh. This action could increase densities of people in open units, potentially increasing disturbance to birds in the open area, but this would be counteracted by higher amounts of undisturbed feeding habitat. Overall, this option would provide proportionally more secure habitat for feeding, nesting, and resting waterfowl and other waterbirds, which would reduce the chances or degree of premature departures, altered feeding patterns, and lowered productivity. Additional nonhunting, public-use opportunities would be provided in part of the area now encompassed by the sanctuary through inclusion of an auto-tour loop, which could potentially increase disturbance levels in this area. However, it could slightly reduce disturbance in the hunt area. Visitors would be restricted to their vehicles, identified pullouts and established trails to minimize direct impacts, including vegetation trampling and nest abandonment which should minimize adverse impacts to waterfowl. Option 2 of Alternative C would allow public use to occur in all existing open areas, but would focus on restricting access points and methods of travel in certain wetland units. While this would not provide the same positive benefits as creating additional inviolate sanctuary, it would reduce hunter densities within identified units and the existing sanctuary would remain inviolate throughout the year. Although Option 1 would provide the most positive benefits to waterfowl, both public-use alternatives would provide lower levels of public-use impacts than would occur under baseline. The potential impacts of Alternative C's public-use programs on waterfowl are addressed in more detail in draft compatibility determinations (Appendix O).

Because the amount of sanctuary would continue to be relatively low under both options, a program would be implemented to monitor the effectiveness of the changes compared to Alternative A.

Alternative D: Similar to Alternative C, this alternative would focus on the simulation of the natural hydrology. Few attempts would be made to alleviate anticipated detrimental impacts to waterfowl populations. With an estimated 5,000 acres of marsh habitat remaining during fall, there would be fewer waterfowl-use days and peak populations would be lower than would occur under all other alternatives, and possibly even compared to existing conditions. It is estimated that the marsh would support approximately seven to eight million total waterfowl use-days. While breeding populations may be higher than other alternatives with higher amounts of spring habitat (estimated 20,000 acres in June), production may be lower due to nest flooding. Increased water supplies to the lower Carson River, combined with removal of cattle and limited efforts to control of saltcedar and perennial pepperweed would enhance waterfowl nesting habitat in this area. This alternative would benefit many species of wildlife but would have an as yet unmeasurable, detrimental impact on waterfowl resources.

Public-use related disturbance would be minimized under this alternative due to the following factors. First, high water during spring periods would allow maximum dispersal of waterfowl resulting in fewer human/waterfowl contacts. Second, no less than 40 percent of wetland habitats would be in inviolate sanctuary, providing disturbance-free zones throughout the year. Furthermore, low water availability during the fall would likely result in fewer waterfowl remaining during this period. This would increase disturbance on habitats open to hunting and other public uses, particularly during fall, although most of the available wetland-habitat during nonspill years would be provided in sanctuary. Overall, this alternative would have positive effects during the breeding season and negative impacts during the fall. However, effects of public use during the fall would be far outweighted by the negative impacts of water management during this time.

Mitigation Measures: The increase in wetland-habitat available for waterfowl during October-December is not anticipated to be as large under Alternative C as it would be under Alternative A. Although this would not be a significant adverse impact, especially considering enhanced wetland-habitat conditions under Alternative C compared to Alternative A, several possible mitigation measures would ensure that waterfowl benefit further, especially in low water years. Additional water could be dedicated for fall use during drought years, rather than emphasizing spring deliveries during these years. Additional farmland planted in waterfowl forage crops would enhance conditions for some waterfowl species. Consistency with the management program would have to be evaluated. A monitoring program would be implemented as an important part of this alternative where the effectiveness of the sanctuaries and walk-in hunt area would be periodically assessed. The comprehensive conservation plan and subsequent public-use management plan would provide flexibility to make adjustments to minimize impacts if unacceptable impacts are detected. Alternative D would have detrimental effects on the ability of the Service to provide for the needs of fall and winter waterfowl and many of these impacts would be unavoidable under this alternative, although some of the aforementioned mitigation could be pursued.

4.4.2.1.2 Shorebirds

The Lahontan Valley wetlands provide critical habitat for a variety of migrating shorebirds. The value of these wetlands to shorebirds was recognized in 1988 when Stillwater NWR and the Carson Lake wetlands were identified as a reserve in the Western Hemispheric Shorebird Reserve Network (WHSRN), one of only 14 such reserves. These reserves are comprised of

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North, Central, and South American wetlands and coastal sites considered to be critical habitat for migrating shorebirds.

Shorebird numbers vary from spring to fall and from year to year depending on water depth and wetland-habitat available. A comparison of wetland-habitat acres in Lahontan Valley (surveyed each August), to August shorebird migration counts between 1989 and 1993 indicates that shorebird populations have declined as wetland-habitat acreage has decreased (Figure 4.3). Stillwater NWR and Carson Lake are the two areas within the Lahontan Valley that attract major concentrations of shorebirds. Shorebird and colony nesting bird-use data for 1972 to 1975 showed that Stillwater NWR and Carson Lake supported 79 percent of the use by these birds in the Lahontan Valley, with the remainder of use occurring in the secondary wetlands at Fernley WMA, Massie and Mahala Sloughs and Soda Lakes.

In the spring of 1987, extensive areas of prime shorebird habitat were available in the Lahontan Valley wetlands as flooded playa wetlands receded. Service biologists observed more than 250,000 shorebirds at that time, with long-billed dowitchers, American avocets, and sandpipers as the three most abundant shorebird species in this extensive, shallow wetland-habitat. Other species, such as black-necked stilts, least sandpipers, marbled godwits, dunlins, and phalaropes are also numerous during migration peaks. Willets, greater and lesser yellowlegs, long-billed curlew, killdeer, plovers, and several species of sandpipers have been observed in the Lahontan Valley during fall and spring migrations, but in fewer numbers than the other shorebird species. Of the shorebirds, American avocet and black-necked stilts are the major species of migratory shorebirds that nest in the Lahontan Valley in substantial numbers. Other shorebirds that nest in, or near, the wetlands include snowy plovers, killdeer, common snipe, long-billed curlew, and Wilson's phalarope. However, there are few records of these species nesting in the Lahontan Valley.

Long-billed curlews nest in limited numbers in uplands and drier areas of the wetlands in the Lahontan Valley. Curlew nesting sites have been documented in the Carson Lake and Stillwater marsh areas. Long-billed curlews forage in wet meadow habitats. Data from the Point Reyes Bird Observatory Counts, conducted at Stillwater, in August between 1989 and 1994, found that the number of long-billed curlew dropped from 195 in 1989, to 25 in 1994. Long-billed curlews occasionally forage at the Pyramid Lake delta and have been sighted along the Truckee River.

Western snowy plover have dramatically decreased in the Lahontan Valley since 1980. Intensive snowy plover surveys were conducted on wetland areas within the Lahontan Valley in 1980, 1988, and 1991. The surveys found that the number of these birds dropped from 761 in 1980, to 74 in 1991. Western snowy plover are a spring and summer resident and transient species. Limited nesting has been documented in Stillwater NWR and Stillwater WMA.

Under existing conditions, the vast majority of shorebirds visit the Stillwater NWR wetlands for three specific purposes; spring migration, breeding, and fall migration. During spring migration, water levels typically increase, which shallowly floods unvegetated alkali playa, wet meadow, and moist-soil habitats. These habitats contain eggs of the previous year's invertebrate populations which, when the are is flooded, hatch and provide food for shorebirds. Because

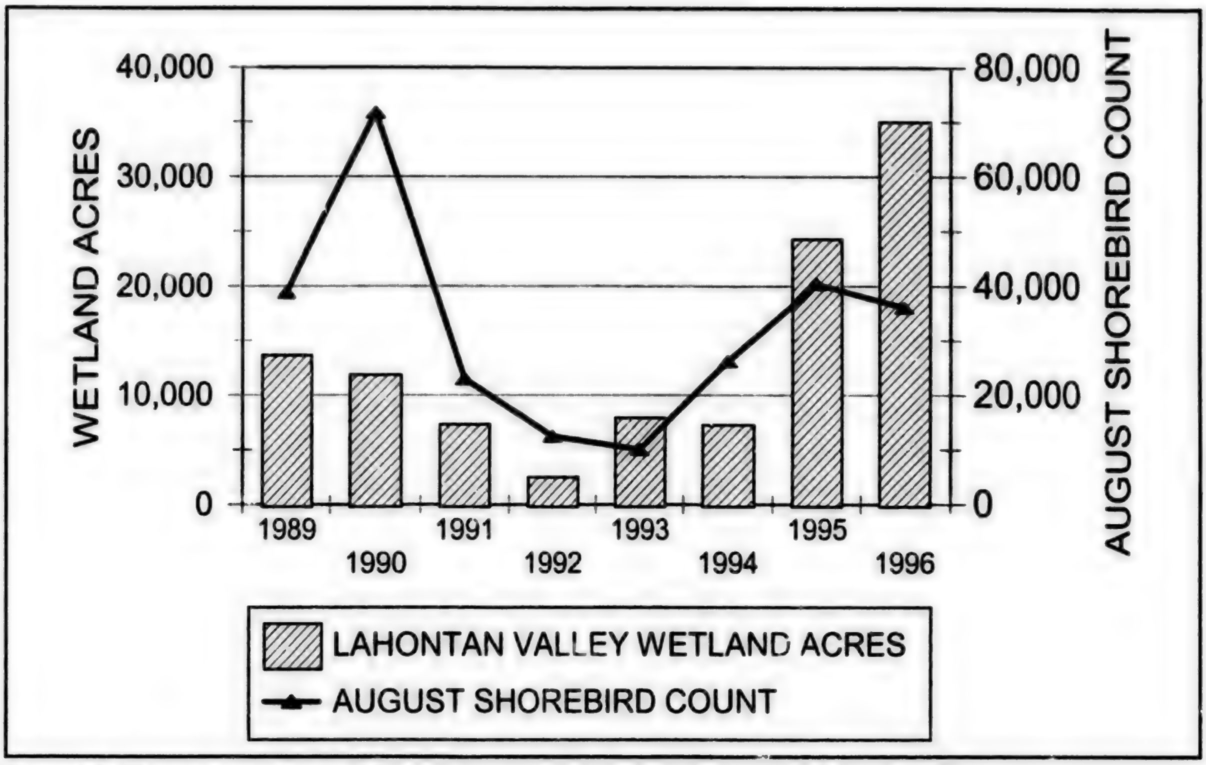

Figure 4.3. Comparison of wetland-habitat acres and shorebird numbers on Stillwater NWR.

waterfowl and spring migration populations of shorebirds also vary by year, only rough estimates can be provided for spring use. With an annual average of approximately 6,600 acres of flooded wetland-habitat in nonspill years, 50,000 shorebirds could use unvegetated alkali playa, wet meadow, and moist-soil habitats during spring migration. An average of 960 to 4,100 acres of these habitats would be provided during the spring.

Some species, such as American avocet, black-necked stilts, killdeer, snowy plovers, and long-billed curlews use the Stillwater NWR wetlands for nesting. Excluding curlew, these species typically select open to lightly vegetated habitats for nesting, where avocets and stilts will form loose colonies on dry, open mudflats. Killdeer and plovers select open habitats where they nest alone, while curlew prefer lightly vegetated uplands. All species select nesting habitats adjacent to unvegetated alkali mudflats (typically located at the northern end of the refuge) or playas where feeding opportunities are optimal. While numbers are not available, large avocet and black-necked stilt nesting colonies were documented throughout Pintail Bay, Swan Lake, Willow Lake, and the Nutgrass units during 1997 (Bundy and Henry 1997). Under estimated existing conditions, the extent of nesting habitat would be much lower than that of 1997, which was a spill year.

Fall migration spans across several summer months, with different species migrating through the wetlands during different periods. As a result, peak populations are not as high as in spring, but

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use would likely continue over a longer period of time. Unvegetated, alkali playas are most heavily used during late summer with summer drawdowns concentrating invertebrates and providing optimal foraging habitats for fall migratory shorebirds. Under existing conditions, approximately 300 to 660 acres of this habitat would be available during late summer.

Most shorebird species appear to be seasonally habituated to public uses throughout the Stillwater NWR Complex, which makes them a favorite observation target during spring and fall migrations (potential impacts of public-use programs on shorebirds are addressed in more detail in draft compatibility determinations, Appendix O; and a review of scientific information, Appendix L). Although wildlife observers and photographers can get relatively close to most species of shorebirds without flushing them, the effects of people approaching shorebirds can have negative physiological effects even if the birds do not appear to be affected (Appendix L). Most species are less tolerant to disturbance during the breeding season with varying effects associated with different uses. For example, killdeer prefer to nest in open, gravelly habitat which often occurs on roadways at the complex. Increased vehicle traffic would increase the risk of nest loss for this species. American avocet and black-necked stilts form colonies on open to lightly vegetated flats and are relatively easy to see for the casual observer. While nest abandonment is uncommon, birds spend more time defending nests than feeding or incubating when observers approach. Alert behavior alone (which occurs any time humans approach) requires more energy than would be used in the absence of humans, thus, requiring more feeding time to replenish depleted energy reserves. This factor is especially important during the nesting season.

Alternative A: Upon completion of the water-rights acquisition program, wet meadow, moist-soil, and unvegetated alkali mudflat habitats would comprise an estimated 1,330 to 4,680 acres of shallow water habitat available for spring migratory shorebird populations. This would provide habitat for an estimated peak spring migratory shorebird population of 100,000 (a 100 percent population increase over existing). Management for less fluctuating water levels would provide optimal nest colony locations (lightly vegetated uplands in northern refuge units); but this alternative would not provide optimal foraging habitats. Limited summer drawdowns would concentrate invertebrate resources for fledgling shorebirds and fall migratory adults in some locations. While available unvegetated alkali playa acreage would be approximately 625 to 1250 acres (twice as much as under existing conditions), less concentration of remaining invertebrate resources would reduce foraging habitat quality. No estimates for breeding or fall migratory populations are available.

Much of the habitat used by nesting shorebirds would be open to wildlife observation and photography, which could result in a relatively high level of interaction between these public-use groups and shorebirds in some areas, such as where roads parallel shoreline areas. During fall migration, shorebirds would likely be minimally affected by people due to lower levels of public use and large scattered habitats used by shorebirds.

Alternative B: Under this alternative, water levels would recede during spring migration, providing relatively little flooding of wet meadow and moist-soil habitats except those that were flooded the previous fall. Therefore, anticipated spring habitat acreage for migratory populations would be lower than that estimated for baseline. Habitat available for breeding populations would be slightly higher with summer drawdown used in this alternative; however, reflooding of habitats, particularly unvegetated alkali playa beginning in August, would provide less concentration of invertebrates for fall migratory populations. Therefore, the amount of spring and fall migration habitat would be lower than would occur under baseline, while breeding habitat acreage would be higher than baseline. The refuge would be closed to the public during the breeding season under this alternative, this would provide higher levels of protection for nesting shorebirds. Human disturbance to shorebirds during other times of the year would be similar to Alternative A.

Alternative C: This alternative focuses on simulation of the natural hydrology which would provide rising water during spring migration and steadily receding water through breeding and fall migration periods. As a result, habitat acreages for spring migrating and breeding shorebirds would be much higher than Alternative A, and habitat acreage for fall migrating shorebirds would be similar to baseline. Receding water levels during late summer, by providing a concentration of invertebrates, would optimize feeding for fall migrating shorebirds. Therefore, while late summer and fall habitat is lower than that of Alternative A, increased habitat quality would provide habitat for larger fall migratory populations. Overall, this alternative would provide more benefits to shorebirds than the previous two alternatives. Public-use impacts would be similar to Alternative A, except that slightly more adverse impacts would occur under Option 1 of Alternative C within the area that is now delineated as sanctuary, especially at East Alkali Lake. In other areas, fewer disturbances would occur during the fall migration due to higher amounts of available habitat.

Alternative D: Similar to Alternative C, simulation of the natural hydrology would produce much higher habitat acreages during spring, provide similar habitat acreages for breeding shorebirds, and result in higher habitat acreages for fall migratory populations. Starting with a higher acreage of wetland-habitat at the outset of the migration period, water levels would decline fairly rapidly thereby concentrating invertebrate resources. This alternative would be similar to Alternative C in benefits provided for spring and summer shorebird populations. Public-use impacts would be similar to those of Alternative C.

4.4.2.1.3 Wading Birds

Under existing conditions, wading birds, including herons and egrets, (white-faced ibis will be covered in a later section) use all habitats where fish, frogs, and other food resources are available for fall and spring migration and summer maintenance. These can include all described habitats at different times of the year (with the exception of deep, open water), waders prefer relatively shallow habitats (6- to 24-inches) where they can wade slowly through the water in search of food. Therefore, wading birds would not be adversely affected by implementation of any of the alternative water-management strategies, but may receive distinct feeding benefits from implementation of the different strategies. With 6,600 acres of wetland-habitat estimated for existing conditions, about 90 percent would be available for wading bird foraging as water depths typically do not exceed 24 inches. Occasional droughts occurring with unstable water availability can affect fish resources which would make many habitats unsuitable for wader foraging use.

Wading birds vary in nest locations. Great blue herons form colonies in cottonwoods and snowy egrets, great egrets, and black-crowned night-herons typically form colonies in deep emergent vegetation. Breeding numbers vary according to the amount of nesting habitat available with deep emergent stands changing annually and great blue heron rookeries remaining relatively static. However, availability of feeding habitats near established rookeries appears to influence the number of pairs using the nesting site. At present, great blue heron rookeries are located along east canal (near Foxtail Lake), on Stillwater Slough south of Stillwater, and near the Weishaupt property just south of the Canvasback Gun Club. Other wading bird colonies can change annually with approximately 990 to 1,980 acres of deep emergent habitat available.

American and least bitterns typically do not nest at Stillwater, but do use the marsh habitats as they migrate through the area. Few of these secretive birds are seen, as they prefer deep emergent habitats near shallow water for feeding. Waders can be present at the refuge during all seasons until the wetlands completely freeze over. As long as there is some relatively permanent water to support fish populations, waders can be observed throughout Stillwater NWR marsh habitats.

During fall and spring migration, herons and egrets are abundant along refuge canals, structures, and many wetland units. Observation suggests that they are tolerant of vehicle traffic during this period, but less tolerant of foot travel. However, as with shorebirds and waterfowl, studies have shown that adverse impacts due to human presence can take place even if birds do not flush. Also similar to shorebirds, there would be increased potential for disturbance impacts on breeding wading birds related to wildlife observation, photography, and to a lesser extent, vehicle traffic. At least one great blue heron rookery is located near a frequently used road. They seem to be habituated to regular traffic but tend to flush when people get out of their vehicles. Egrets and black-crowned night herons tend to nest in emergent vegetation. While vehicle and foot travel are unlikely to have adverse impacts, boat travel around established colonies tends to flush nesting waders. No estimates on nest abandonment associated with boating activity are available but this is a possible impact associated with boat use. Another factor is that when birds are flushed from their nests, there is increased loss of eggs due to nest predation. It is possible that public use activities affect the distribution of fall migratory and wintering wading birds by influencing the timing of migration from the refuge or by changing the distribution of waders between sanctuary and open units on the refuge. However, this observation requires further monitoring to form accurate conclusions.

Alternative A: This alternative would benefit wading birds over existing conditions by providing more permanent water for fish populations, through management for less fluctuating water levels. Overall wetland-habitat would be approximately 12,500 acres on Stillwater NWR with water depths averaging slightly deeper than existing. Therefore, available marsh habitat acreage would greatly increase, but a slight decrease in optimal foraging habitat (6 to 24 inches) would result based on increasing water depths throughout the wetland units as compared to existing. Nevertheless, there would be an increase in available foraging habitat under Alternative

A. While breeding habitat for great blue herons would be similar to existing, there would be an increase in deep emergent habitat for other wading bird breeding colonies. Under this alternative, approximately 2,000 to 4,000 acres of deep emergent vegetation would be available, which would also provide additional migration habitat for bitterns. Boat traffic would continue during breeding season under this alternative, which could result in increased flushing of nesting wading birds. Vehicle travel would continue near heron rookeries with no regulations protecting the nesting great blue herons. Overall, public-use impacts would be similar to existing conditions with more water available for dispersion of nest-colony sites.

Alternative B: Similar to Alternative A, more permanent water would be available, providing increased survival of fish populations over existing conditions. However, this alternative would result in summer drawdowns which could reduce fish populations in some management units. Tui chub, carp, and other fish species would continue to exist in most units, except those completely drawndown. This management strategy provides benefits for wading birds by concentrating fish during summer drawdowns. Therefore, foraging habitat quality during summer months would be higher than baseline, but lower throughout the annual cycle.

It is possible that heron rookeries might experience lower habitat quality than baseline if units adjacent to established rookeries are dewatered. However, higher densities of fish during drawdowns could improve foraging opportunities and the adult's ability to feed their young. Deep emergent habitat acreage would be similar to baseline with 2,000 to 4,000 acres of potential nesting habitat available. Although the adult's ability to feed their young could be higher than baseline, fall accessability to fish would be lower. Fall migratory and wintering populations would likely experience lower habitat quality, because there would be fewer fish dispersed over more acres, thus, providing lower densities of fish than under Alternative A. Under this alternative, cottonwood trees, used for nesting, would continue to be replaced, to a limited extent.

Boating impacts on marsh-nesting species would be lower than baseline with the restrictions on boating during March 1 to August 1. This would have additional benefits related to colonies established near areas that are easily accessible by foot travel. Because most of the river corridor would no longer be under Service protection, great blue heron rookeries along the lower Carson River could be subject to higher public use than baseline. Hunting related disturbance would be lower than existing because more wetland habitat would be available resulting in a lower density of hunters within wetland habitats.

Alternative C: High spring water-inflows resulting from simulation of the natural hydrology would decrease density of fish for spring migratory populations, but could help reestablish natural levels of fish reproduction under this alternative. In many marsh related fish populations, high water extending into wet meadow habitats provides optimal breeding conditions for native fish. Thus, it is possible that while fish densities would be lower than baseline throughout the marsh, higher densities could result in these newly flooded shallow habitats which are optimal foraging zones for wading birds. Summer drawdowns would result in similar foraging conditions to Alternative B. Breeding birds would benefit from this management strategy by similar concentration of fish through summer months. Flooding some units during fall would promote survival of fish throughout the annual cycle. Therefore, if native fish breeding occurred in newly flooded wet meadows, spring foraging opportunities would be higher than, breeding habitat quality would be higher than, and fall foraging habitat acreage would be lower than baseline under this alternative.

While this alternative would have little effect on previously established heron rookeries, it is likely that restoration of riparian habitats would provide additional rookery sites over the long term. As cottonwoods, replaced through restoration efforts, mature, new sites would become available, especially where adjacent to ideal foraging habitat, such as along the Carson River.

Public-use impacts would be similar to Alternative B for breeding wading birds with the exception that riparian rookeries located along the Carson River corridor would be within the Alternative C boundary and would receive greater protection than under Alternative A. Trails along the lower Carson River would be designed and managed to minimize adverse impacts to nesting colonies. Hunting related disturbance would be lower than baseline with either the addition of two inviolate sanctuary units (Option 1) or two limited-access units (Option 2). Higher levels of vehicle traffic associated with development of a tour loop within the existing sanctuary (Option 1) is anticipated to have few additional negative impacts on wading birds, except that adverse impacts could occur in localized areas.

Alternative D: Full simulation of the natural hydrology would result in conditions similar to Alternative C, with the exception that summer drawdowns would result in a much smaller "minimum pool." This could result in fish mortality between wetland units where deep channels are not available for overwintering fish populations. In addition, remaining fish populations would be spread over a larger acreage during the spring, thus, decreasing density and availability of fish populations to foraging wading birds. Similar to Alternative C, wading birds would benefit through restoration of the riparian corridor and associated creation of additional rookery sites. As compared to Alternative A, wading birds would be adversely affected on an annual basis, but would have some benefits through riparian restoration and spring habitat availability.

Public-use opportunities would be higher during the spring and summer under this alternative as compared to Alternative A, possibly increasing levels of disturbance in wetland habitats. Access to the great blue heron rookery on lower Foxtail Lake would be facilitated through creation of a photo blind at this site, which has the potential to adversely impact nesting birds. A larger number of observation points would be constructed under this Alternative than under Alternative C, which could further increase disturbance in localized areas. Hunting disturbance would be lower refuge wide, but higher in huntable units with anticipated higher hunter densities in these areas. All other anticipated public-use related impacts would be similar to Alternatives A, B, and C.

4.4.2.1.4 Colonial Nesting Waterbirds on Anaho Island

Under existing conditions, Anaho Island NWR provides nesting habitat for American white pelicans, California gulls, double-crested cormorants, Caspian terns, black-crowned night-herons, great blue herons, and a few Canada geese (Canada geese are not considered colonial nesters but individual nests have been documented on Anaho Island NWR). The same level of protection would be provided to Anaho Island NWR under all alternatives as it is provided under existing conditions. The amount of habitat on Anaho Island is affected by water levels of Pyramid Lake. When the refuge was first established, water levels were still relatively high in the lake and the refuge (island) measured approximately 247 acres. By 1977, when the level of the lake had declined to about 3,788 feet in elevation, the size of the island had increased to about 747 acres. Given the recent consecutive series of high water-years, the elevation of the water surface rose to about 3,809 feet by July 1997, bringing the size of the island back down to an estimated 575 acres. Under baseline conditions, including increased lower Truckee River flows resulting from Adjustments to OCAP and water-rights acquisitions for Lahontan Valley wetlands, the lake level would be an estimated 3,840 feet, which is similar to the elevation that would exist under Alternative C in the long term (Table 4.6). At this water-level elevation, the size of the island would be about 425 acres. Under Alternative B, the lake level would be slightly lower (an estimated 3,839.5 feet), which would provide slightly more nesting habitat over the long term. Under Alternative D, it is estimated that the lake level could rise an additional 0.4 feet over that estimated for Alternative A, which would have negligible effects on the amount of available nesting habitat on the island (a difference of less than 10 acres).

Breeding success is related to feeding habitat that is located throughout Pyramid Lake (primarily the Truckee River delta), and in the case of white pelicans, Stillwater Marsh and other wetlands in the Lahontan Valley, lower Humboldt River, and other wetlands in western Nevada near Pyramid Lake. Therefore, the foraging habitat quality in Stillwater Marsh, resulting from each alternative being considered, could affect the ability of adult white pelicans to feed their young and to attain energy for migration. The effects of the alternatives on prey fish are addressed in the previous wading bird section, and the potential effects on white pelican feeding habitat on Stillwater Marsh is addressed in more detail in the following section. Alternative C would likely provide the best benefits for white pelicans flying from Anaho Island to Stillwater Marsh to obtain fish. Because public access to Anaho Island is prohibited, few public-use impacts would be anticipated under any of the alternatives.

4.4.2.1.5 Other Waterbirds

All other groups of waterbirds are addressed in this section: American white pelicans, rails, gulls, terns, coots, grebes, and double-crested cormorants. Under existing conditions, an estimated average of 6,600 acres of wetland-habitat would be provided during nonspill years. Because waterbirds would mainly be affected to the extent that their habitat is affected, readers are referred to the previous habitat section for information on potential effects of alternatives on wetland-habitat acreage. This discussion will focus on impacts to each of these groups relative to implementation of each alternative.

American white pelicans: The importance of Anaho Island to this species has been previously discussed; however, pelicans also use Stillwater Marsh to forage to either feed young or to gain energy for upcoming life history events. Pelican use of the marsh is closely tied to the availability of fish, which are typically optimized through a combination of permanent water management, followed by drawdown to concentrate fish for foraging. This combination would be best accomplished through implementation of Alternatives B and C. However, all alternatives would provide more benefits to American white pelicans, over existing conditions, through increased foraging habitat acreage. Public-use impacts would be anticipated to be light under all alternatives, particularly under Alternatives B, C, and D related to closure of the wetland areas to foot traffic, except designated areas, and boating during the breeding season.

Rails: Two rail species, sora and Virginia, are commonly heard within the Stillwater Marsh system. Although they are secretive and rarely observed, large populations can use the wetlands for spring and fall migration and breeding. Rails are commonly associated with deep emergent habitats which they use for all of the aforementioned life history events, thus, Alternatives A and C would likely provide the most seasonal benefit to rails. Public-use impacts would be similar to those described for breeding wading birds.

Gulls: Four gull species are commonly associated with the Stillwater Marsh including California, Franklin's, Bonapartes, and ring-billed. While each of these species has different habitat requirements all use selected habitats (usually submergent vegetation) for migration. California and Franklin's gulls may breed in the area. Gulls are general in prey selection, but, will commonly seek small fish, thus, Alternatives B and C would provide the most foraging benefit by concentrating fish resources through summer and early fall. California gulls nesting in the marsh system can form colonies on open islands surrounded by unvegetated mudflats, thus, all alternatives subject to summer drawdown (Alternatives B, C, and D) would provide habitat for nesting California gulls. More secretive during nesting, Franklin's gulls build nest platforms within deep emergent habitats. Alternatives A and C would likely provide the best nesting conditions for this species. Closing refuge wetlands to foot traffic, except designated areas, and boating during the breeding season would minimize public-use impacts under Alternatives B, C, and D.

Terns: Caspian, Forsters, and black terns are all common migratory visitors to the Stillwater NWR complex. Similar to gulls, all species typically select small fish as prey. While black terns are generally seen only during fall migration, Caspian and Forsters terns also breed in the Stillwater Marsh. Forsters terns are most abundant and select open shoreline directly adjacent to dense vegetation stands for nest sites. Caspian terns are an occasional nester at Stillwater and typically form colonies on open islands adjacent to foraging habitats, such as deep open-water or submergent vegetation. Considering the similarities to gull species' requirements, Alternatives A and C would likely provide the most direct benefits to tern species. Closure of refuge wetlands to foot traffic, except designated areas, and boating during the breeding season would tend to minimize public-use impacts under Alternatives B, C, and D.

Coots: At present, American coots are the most abundant species using the Stillwater Marsh. In most years, in excess of 100,000 are distributed throughout the refuge, with populations generally peaking during late summer. The largest concentrations are associated with open, submergent vegetation where they graze the leaves from various pondweed species; however, they also use adjacent, deep emergent habitats to build overwater nest platforms. While all alternatives would increase the amount of available habitat over existing conditions, Alternatives A, C, and D would provide the most submergent and deep emergent habitat mix. Overall, Alternative A would likely offer the most benefit to American coots based on less fluctuating water levels throughout the year and the resulting establishment of submergent vegetation. Public-use impacts would be similar to those described for breeding wading birds.

Grebes: Four grebe species are common inhabitants of the Stillwater Marsh including Clark's, western, pied-billed and eared. All species use deeper water habitats for migration and breeding with pied-billed grebes often seen throughout the year. Typically related to small fish populations, these species often forage in submergent, deep emergent, open water, and canal habitats where clear water conditions prevail for these sight feeders. Optimal habitat for grebe foraging would likely be produced through implementation of Alternatives A, C, and D. Public-use impacts would be similar to those described for breeding wading birds.

Clark's, western, and pied-billed grebes are solitary nesters, constructing overwater platforms in deep emergent vegetation. Eared grebes, on the other hand, form tight colonies in submergent vegetation, building nests from the leaves of various submergent aquatic plants. The former three species would obtain breeding benefits from Alternatives A and C while eared grebes would receive more benefit from Alternatives A, B, and C. Similar to all other waterbird species discussed, Alternative C's water-management strategy of high spring flows could adversely impact breeding species which build overwater nests in deep emergent habitat by flooding nests prior to hatch. This is particularly true with Clark's and western grebes which often begin nesting during early spring. While this alternative would provide benefits related to grebe foraging habitat and eared grebe nesting habitat, Alternative A would likely provide the best overall conditions for grebes.

Double-crested cormorants: Similar to grebe species, cormorants prefer foraging in clear, deep water with abundant fish populations. Seasonally, these habitats would be optimized through implementation of Alternatives C and D. Cormorant nesting does not usually occur within the Stillwater Marsh; however, nesting colonies have been located in some of the Lahontan Valley's irrigation reservoirs (particularly S-Line) and in the Lahontan Reservoir. Breeders rely on marsh habitats to provide fish for nesting young, adults are often observed leaving established colonies to pursue fish in shallower marsh habitats. Cormorants can be observed foraging in the marsh during spring, summer, and fall and would likely receive the most benefit from implementation of Alternative A. Public-use impacts would be similar to those described for pelicans.

4.4.2.1.6 Passerines

There are both upland dependent and marsh dependent passerine (or songbird) species that inhabit Stillwater NWR, Stillwater WMA, and Fallon NWR. Marsh-dependent passerine species include long-billed marsh wrens, common yellowthroats, yellow-headed blackbirds, savannah sparrows, and song sparrows. Tree, bank, barn, and cliff swallows use marsh habitat for roosting and feeding. Savannah sparrows, Western meadow larks and common nighthawks nest on the ground in meadow and upland areas, and forage in wet meadows consisting of rush and saltgrass plant communities.

The diversity of passerine species in the Stillwater NWR Complex is associated with riparian habitat. These areas provide a mix of cottonwood, willow, Russian olive, cattail, grass, and other stream-side plant communities and act as transition zones between water, such as rivers, canals, and drains and upland habitats (e.g., desert, agricultural). This provides a diversity of habitats within a small area to support many species.

Many of the passerines associated with riparian areas on Stillwater NWR and Stillwater WMA are neotropical migrants (birds that winter in Central and South America but nest in North America, including the Lahontan Valley). Examples of species that depend on, or are associated, with riparian areas include Western wood peewees, house wrens, yellow warblers, MacGillivray's warblers, Bewick's wrens, black-headed grosbeaks, and Northern orioles. Many species associated with marsh, agricultural, and desert plant communities also make use of riparian habitats.

Streamflows affect the quality of riparian forest habitat by influencing corridor width, stand size, and age of cottonwood forest. The size and width of cottonwood-willow riparian forests along the lower Carson River have been reduced, in part, because of agricultural activities, livestock grazing, and a decline in periodic high streamflows necessary for cottonwood regeneration and maintenance. Furthermore, older, large-diameter cottonwood trees which die are not being replaced due to the lack of regeneration. As a result, species which require large-diameter trees for nesting and/or roosting are adversely affected. Along the Carson River, sapsuckers, downy woodpeckers, and northern flickers require large cottonwoods in which they excavate their own nest cavity (primary cavity nesters). These species are important because their nest sites are subsequently used by secondary cavity nesters (occupy cavities excavated by another species). Along the lower Carson River, native secondary cavity nesters include American kestrel, common merganser, house wren, tree swallow, violet-green swallow, and wood duck. Two introduced secondary cavity nesting species (house sparrow and European starling), which compete with native cavity nesters for nest sites, are common along the lower river.

Common ravens, black-billed magpies, and American crows are also found at Stillwater NWR, Stillwater WMA, and Fallon NWR. These birds commonly nest in riparian and upland areas but feed in and near the wetlands, and agricultural areas. Populations appear to be higher than they were prior to the introduction of agriculture and other developments in the Lahontan Valley.

Some species, such as sage thrashers, black-throated sparrows, and sage sparrows depend on desert plant communities where shrubs dominate the communities. Other species, such as water pipits, horned larks, and Western meadow larks, forage in plant communities dominated by such plants as alkali wild rye, saltgrass, and iodinebush. The loggerhead shrike is a species of concern that nests in greasewood but also uses riparian areas, areas bordering marshes, and agricultural areas.

Common passerines on Anaho Island include rock wren, house finch, white-crowned sparrow and Savannah sparrow. Appendix C lists passerines and other birds using Anaho Island.

Riparian areas under existing conditions are inhabited by common, widespread species. Several native passerine species, with narrow habitat requirements, no longer occur along the lower Carson River or Stillwater Slough (e.g., yellow-billed cuckoo, yellow-breasted chat). Degraded riparian habitat conditions are a result of a significantly depleted water supply, season-long cattle grazing, and encroachment by invasive vegetation. Human activity in riparian areas and other habitats has the potential to adversely affect passerine birds, but in general effects do not appear to be as high as they can be on waterbirds. In the uplands, some passerine species may be affected by altered vegetation composition and structure. Data on passerines in all habitats is limited.

Public use impacts on passerine species are thought to be minimal under all alternatives. Under all alternatives, passerine populations outside Stillwater NWR, Stillwater WMA, Fallon Refuge, and Anaho Island NWR would not be affected by the actions being considered in this Draft EIS. Passerines using Anaho Island would not be affected any of the alternatives.

Alternative A: Passerine richness and abundance would be similar to existing conditions, except for the abundance of several marsh-dwelling species, which would be substantially higher in the long term under Alternative A. The average amount of marsh habitat is expected to double by the completion of the water-rights acquisition program. Therefore, the local raven population would benefit, although increased wetland-habitat acreage may not result in a higher population. With no water dedicated to the lower Carson River and without adequate control of cattle grazing and invasive vegetation, the native diversity of riparian birds along the lower Carson River and Stillwater Slough, and at the delta of the Carson River would continue to decline as cottonwood trees continue to die without being replaced, floodplain vegetation continues to be heavily grazed, and native vegetation is replaced by saltcedar, Russian olive, perennial pepperweed, and other nonnative species. Upland dwelling passerine species may also continue to be negatively affected by depleted Indian ricegrass and other perennial bunchgrasses, dominance by cheatgrass, and possibly in the long term, conversion of greasewood and other desert shrub communities to cheatgrass communities.

Alternative B: Passerine richness and diversity would be similar to that under Alternative B over the long term, except that reduced livestock grazing would, to a limited degree, positively affect passerine species associated with tall, dense floodplain meadow vegetation. Without an aggressive control program for saltcedar and other noxious weeds in this habitat, benefits of reduced livestock grazing in these areas would be limited. Use of Stillwater NWR by ravens would be lower under this alternative than under Alternative A due to the introduction of a predator control program. Impacts from public use would be similar to Alternative A.

Alternative C: Under this alternative, passerine diversity in Stillwater Marsh would be similar to Alternatives A and B, although the use of the marsh during the breeding season would be somewhat higher under Alternative C. Under Alternative C, there would be an estimated 36 percent more available habitat than under Alternative A and there would be more emergent marsh habitat. The raven population would be similar to that of Alternative A, except to the extent that it is shown that the local population is measurably higher than natural levels (at which time it would be brought in line with these estimates).

Along the lower Carson River (from Timber Lake north) and Stillwater Slough, riparian-dependent birds would benefit slightly in the short term under Alternative C, due to the discontinuation of cattle grazing along riparian areas, control of saltcedar and noxious weeds, and restoration of native vegetation along riparian corridors. In the long term, as additional areas are protected, livestock grazing is brought under control, saltcedar is reduced in abundance, and to the extent that water is secured for the lower Carson River, the use of riparian areas by passerines would increase. Furthermore, establishment of cottonwood and willow communities in the long term, especially large stands having considerable vegetative structure would have the potential to increase the number of passerine species using the lower Carson River and Stillwater Slough, and could potentially result in reestablishment of breeding populations of yellow-billed cuckoos, yellow-breasted chat, and other species associated with this habitat.

Establishment of native floodplain meadow vegetation would add a missing component to the native passerine community. Relationships between upland vegetation condition, cattle grazing, and upland passerine communities are unclear on the Stillwater NWR. It is hypothesized that passerine communities in upland areas would move closer to a native diversity under Alternative C, as cattle grazing is phased out and upland habitats recover. However, this would not apply to areas dominated by cheatgrass, which would be unaffected by any of the alternatives, except that exclusion of livestock from uplands could reduce the spread of cheatgrass. In the long term, the potential would continue for greasewood and other desert shrub communities to convert to cheatgrass communities (due to fire), which would adversely affect upland passerine communities.

Some of the benefits of riparian restoration could be offset in localized areas due to the construction of wildlife-observation trails and other observation points along the lower Carson River, and a visitor facility near the Stillwater Slough. However, overall adverse impacts are not anticipated to be of concern.

Alternative D: Under this alternative, passerine species would benefit to an extent similar to Alternative C, except possibly in riparian areas where benefits would be somewhat lower due to restrictions on techniques to control saltcedar, perennial pepperweed, and other invasive nonnative species. Also, breeding populations in Stillwater Marsh would be greater under Alternative D than under Alternative C, and would be an estimated 56 percent higher than under Alternative A. Effects of public-use activities and facilities on passerine birds would be similar to those summarized under Alternative C.

4.4.2.1.7 Raptors

A variety of raptor species inhabit Stillwater NWR, Stillwater WMA, and Fallon Refuge for breeding, migration, and wintering. The different species use marsh, riparian, upland, and agricultural habitats.

Wetland-dependent raptors found at Stillwater NWR, Stillwater WMA, and Fallon NWR, include bald eagles, northern harriers, peregrine falcons, ospreys, and short-eared owls. Raptor species, such as golden eagles, prairie falcons, red-tailed hawks, Swainson's hawks, rough-legged hawks, Cooper's hawks, sharp-shinned hawks, American kestrels, turkey vultures, great horned owls, long-eared owls, screech owls, and common barn owls inhabit Stillwater NWR, Stillwater

WMA, and Fallon NWR as year-round residents, migrants and nesters. These species are not wetland dependent, however, because they are opportunistic hunters, some species can be found, at times, hunting in wetland-habitats.

Species associated with riparian tree communities include red-tailed hawks, Swainson's hawks, Cooper's hawks, sharp-shinned hawks, American kestrels, great horned owls, long-eared owls, screech owls, and common barn owls. Most of these species use trees provided in riparian areas, and other areas supporting trees, for nesting and for hunting perches from which to scan adjacent upland or agricultural areas for prey.

Short-eared owls and northern harriers nest in wetland-habitats on Stillwater NWR, Stillwater WMA, and Fallon NWR. There are only three active osprey nests in Nevada, and one of those has existed on the Newlands Project's S-Line Reservoir since 1989. In 1993, osprey nesting in the area failed.

Burrowing owls nest in upland areas on Stillwater NWR, Stillwater WMA, and Fallon NWR. American kestrels commonly nest in cavities of cottonwood snags along irrigation ditches, farm fields, river channels, reservoirs, and wetlands. Swainson's and red-tailed hawks, and great horned owls commonly nest in live cottonwood trees scattered throughout the Lahontan Valley. The nesting population of Swainson's hawk appears to be expanding in the valley. Ongoing conversion of agricultural land and associated riparian areas (where cottonwoods commonly grow) to housing subdivisions directly impacts raptors that use these lands and associated cottonwood trees.

Rough-legged hawks are observed on Stillwater NWR, Stillwater WMA, and Fallon NWR from November to late March. Other raptor species, such as merlins and ferruginous hawks, are uncommon winter residents and migrants. Although not abundant, ferruginous hawks are an infrequent, fall migrant and winter resident in Lahontan Valley. This species is regularly sighted in the area between Sagouspe Dam and Diversion Dam, in the Stillwater agricultural district, and at Indian Lakes. It has also been sighted along the Truckee River. Red-tailed hawks and golden eagles are commonly seen flying over Anaho Island. In addition, there are historic accounts of a bald eagle nest on Anaho Island and peregrine falcon nesting on Pyramid Island.

Under existing conditions, a long-term average of an estimated 6,600 acres of wetland-habitat would exist in Stillwater Marsh during nonspill years, which would provide marsh habitat for a variety of raptor species. Readers are referred to the previous section for the discussion on riparian habitat. Public-use impacts are anticipated to be minimal under all alternatives with the exception that increased public-use of Timber Lakes under alternatives C and D could potentially impact wintering bald eagles in this area. Confining use to established trails and closing trails during peak bald eagle use periods should eliminate this impact.

Alternative A: Populations of raptors breeding in or near Stillwater Marsh (e.g., northern harriers and short-eared owls), and those using the marsh during winter (e.g., bald eagles) would be maintained at moderately high levels given favorable conditions in the marsh and long-term consistency in habitat availability from year to year. Wetland-habitat acreage would be twice as high as it is under estimated existing conditions. The status of those associated with riparian areas and uplands would be similar to existing conditions in the short term, but would decline to the extent that riparian habitat continues to degrade.

Alternative B: Populations of raptors associated with marsh habitats would be similar to those under Alternative A, except that wintering populations, would benefit slightly more under Alternative B. Furthermore, wet-meadow habitat would be enhanced in some areas due to reduced livestock grazing, this would benefit some species, such as northern harriers. While some raptors could be slightly affected by the establishment of a farming program (using lands that otherwise would have converted to upland habitat in the long term), others would benefit slightly.

Alternative C: Breeding populations of raptors associated with marsh habitats would benefit under this alternative over the long term, as an estimated 36 percent more marsh habitat would be available. Additionally, wet-meadow and floodplain meadow habitat would be enhanced to a greater degree than Alternative B, due to significantly reduced cattle grazing in these habitats, and more flooded acres in the spring. Conversely, less wintering habitat, and associated prey species, for wetland-associated species would be available under this alternative than under baseline conditions (Alternative A), an estimated 17 percent less. However, with respect to bald eagles, riparian cottonwood communities (important for night roosts) would be enhanced under this alternative; however, this is not anticipated to offset the effects of less wetland-habitat. Another potential effect is increased human disturbance to bald eagle roost sites and raptor nesting along the lower Carson River. Facilities would be designed to avoid or minimize these impacts.

In the long term, enhanced riparian conditions resulting from exclusion of cattle grazing along riparian corridors, control of invasive vegetation, and possibly additional and more consistent water flowing down the Carson River would benefit raptor species associated with riparian areas. Effects of establishing a farming program on raptors would be similar to the effects identified under Alternative B.

Alternative D: Effects of Alternative D on raptor species would be similar to the effects of Alternative C, except that breeding populations of marsh raptors would benefit more under Alternative D and riparian associated species would not benefit as greatly. Furthermore, wintering populations of raptors associated with marsh habitats would be adversely impacted by Alternative D, as compared to Alternative A as well as compared to existing conditions. Wintering habitat would decline slightly compared to existing conditions and would be an estimated 50 percent lower than Alternative A, baseline conditions. Human disturbance effects would be similar to those of Alternative C.

4.4.2.1.8 Other Bird Species

Alternative A: Populations of upland fowl species and mourning doves inhabiting the Stillwater NWR area would continue much as they are today, except that populations associated with farmland near the town of Stillwater could be adversely affected over the long term as farmland is converted to native upland habitats. These impacts are part of baseline conditions, however, as they were addressed in the Lahontan Valley Wetlands Water-Rights Acquisition Program Final EIS. Public-use impacts continue to occur, but at relatively low levels for all species under existing and baseline conditions. Hunted species would continue to be affected during the hunting season, but hunting pressure is light.

Alternative B: Populations would be similar to those under Alternative A, except that populations associated with farmland near the town of Stillwater would benefit from the establishment of farming on 300 to 400 acres within refuge boundaries (as compared to allowing this land to convert to upland plant communities).

Alternatives C and D: Under these alternatives, species associated with riparian areas (e.g., California quail, mourning doves) would benefit from Alternatives C and D, especially Alternative C. Riparian benefits would be highest under Alternative C and a limited amount of farmland would be established under Alternative C (200 to 300 acres), providing additional benefits to some species, where none would be maintained under Alternative D.

4.4.2.1.9 Avian Diseases

Under existing conditions, avian botulism, fowl cholera, and lead poisoning are the primary diseases of concern on Stillwater NWR, Stillwater WMA, and Fallon NWR. Avian botulism is typically an annual occurrence, the severity of which is determined by hot, dry summers and associated low water conditions. Two methods for control of this disease include drying units where outbreaks occur, and ensuring that diseased birds and carcasses are completely removed from infected units. Botulism bacteria are always present in the marsh system; our ability to control water levels is our best defense for preventing these bacteria from becoming active.

Fowl cholera generally occurs during late fall, winter, and early spring, with concentrations of birds directly associated with the severity of the outbreak. Typically transferred from bird to bird, the ability of waterbirds to spread out between marsh habitats and the Service's ability to reduce waterbird concentrations are the best mechanisms for control. Fewer cholera outbreaks occur compared to botulism outbreaks, but the severity can be similar when large numbers of birds concentrate in the same area.

Lead poisoning results from concentrations of lead shot left over from the time before steel shot became mandatory for waterfowl hunting. Lead tends to concentrate in surface sediments, where foraging waterbirds search for invertebrates, seeds, and grit. Mistaking the lead shot for food or grit, waterbirds consume it and the shot lodges in their gizzards, slowly decreasing the capacity for the waterbirds to digest food. While little can be done for remaining lead shot in the marsh, the elimination of lead shot for hunting and sediment layers burying remaining lead shot in the marsh system are slowly decreasing the severity of this disease. The only management available for control is to flood units where considerable lead shot remains, above levels where waterbirds can effectively forage through the bottom sediments. Lead poisoning occurrences are fairly uncommon under existing conditions and will likely not be a factor over the next several years as sediments slowly build over lead shot deposits.

Alternative A: Under this alternative, water inflow would be more than 100 percent higher than under existing conditions, and water levels would fluctuate less than under existing conditions. This would maintain wetland-unit water depths through late summer months, thus lowering the potential for severe botulism outbreaks as compared to existing conditions. Additionally, there would be a 100 percent increase in wetland-habitat acreage which would allow waterbirds to spread out over additional marsh habitat which would decrease the potential for fowl cholera outbreaks. Lower waterbird concentrations would be provided through this acreage increase which would decrease the potential for infected waterfowl to come into contact with large waterfowl concentrations. Lead poisoning would be somewhat reduced with higher water levels than occurs under existing conditions.

Alternative B: Under this alternative, summer drawdowns would provide conditions for higher occurrences of botulism outbreaks than under Alternative A. This could be counteracted by flushing the affected marsh units with fresh water or by completely drawing these units down to eliminate waterbird use. No restrictions are imposed on water use for this purpose under this alternative. Fall, winter, and spring wetland-habitat acreage would be higher than baseline, which would provide more protection against fowl cholera outbreaks. Potential for lead poisoning would be similar to existing conditions. Management options would be similar to those under Alternative A to protect against and control disease outbreaks.

Alternative C: Simulation of the natural hydrology would provide higher water levels during the spring, but would result in evaporative summer drawdowns. Similar to Alternative B, this would potentially result in higher occurrences of botulism outbreaks than under Alternative A, which could be counteracted through freshwater inputs and/or complete draining of marsh units. Production of fall and winter wetland-habitat could be somewhat lower than baseline, which could result in more opportunity for fowl cholera outbreaks. This assumes that less wetland-habitat during these seasons would increase the potential of higher waterfowl concentration, which would lead to a higher possibility of disease transmission. To the extent this is true, the ability to passively control diseases (e.g., provide large acreages of habitat to disperse birds) would be limited. Use of control techniques would be somewhat lower than baseline due to a lower availability of water in the fall, but sufficient water would be available to control diseases.

Alternative D: Outbreak potential would be higher than under Alternative C; however, only limited levels of disease control would be initiated under this alternative (unless severe affects on local and/or continental waterfowl populations could be determined). This alternative recognizes that botulism and fowl cholera outbreaks were a natural part of the historic Stillwater Marsh functioning, and natural levels of disease outbreak would be tolerated. Overall, potential for avian disease outbreaks is higher than baseline, but numbers of birds would be far less.

4.4.2.2 Mammals

Mammals are found throughout Stillwater NWR, Stillwater WMA, and Fallon NWR, with the highest diversity occurring in the upland desert plant communities. Specific data on mammal populations within the area are limited, but 49 species from 15 families have been recorded in the area. Appendix B lists the characteristic mammal species of Stillwater NWR, Stillwater WMA, and Fallon NWR.

Upland mammals comprise the largest number of species, have the widest distribution, and account for the largest mammal populations on Stillwater NWR, Stillwater WMA, and Fallon NWR. They range in size from pocket mice to mule deer. All nondomesticated species of upland mammals occurring in the area are native.

About two-thirds of the upland mammal species in the affected area are rodents, and nearly all of these are primarily associated with desert plant communities (Appendix B). Examples of rodents that can be found in lower elevation greasewood communities are white-tailed antelope ground squirrels, pale kangaroo mice, and Great Basin kangaroo rats. Some species of desert rodents, such as Merriam's kangaroo rat, can be found in alkali flats that are nearly devoid of vegetation. Seed-eating rodents, such as kangaroo rats, kangaroo mice, and pocket mice are important seed dispersal agents for many desert plants, especially Indian ricegrass. These rodents gather seeds and store them in small caches in shallow depressions on the ground surface and cover them with soil. Under the right conditions, these seeds will germinate and new plants will grow.

Mule deer populations have increased in recent years in the area of Stillwater NWR and Stillwater WMA and are close to, or at record levels in the Lahontan Valley. Black-tailed jackrabbits are common throughout desert plant communities in the area. The most common carnivore in the valley is coyote. Kit foxes also occur on Stillwater WMA. Striped skunks are uncommon at Stillwater NWR and Stillwater WMA and bobcats are rare. Long-tailed weasels were common in Lahontan Valley in the 1950s, but are now rare.

Beaver, mink, and raccoons were once common in the Stillwater NWR wetlands and other parts of the Lahontan Valley. Mink are now rare. However, beaver are likely more abundant at present than they have been in the past. Beaver may have been introduced into Lahontan Valley prior to the turn of the century as a means of increasing the fur harvest in Nevada, but this has not been substantiated. Beavers are frequently found along the Carson River and occasionally found in canals and drains. Raccoons were common along the Carson River and Newlands Project canals and drains in the 1950s, but are rarely encountered now.

Muskrat are one of the most numerous wetland-dependent mammal species, and are found in marsh communities and along the Carson River, canals, and drains. Until the recent low-water years, muskrats were trapped in considerable numbers. During the low water years of the late 1980s and early 1990s, the muskrat population dropped to a remnant of its former size due to the loss of wetland-habitat. However, the muskrat population is increasing again as a result of Lahontan Reservoir spill-water expanding the size of wetland-habitat on Stillwater NWR during the high water years of 1994 to 1998.

Other mammals that inhabit marsh and riparian areas include the Western harvest mouse and the long-tailed vole. Western harvest mice prefer dense vegetation near water. Cavities in cottonwood snags (dead trees) serve as den or resting sites for mammals, such as bats, raccoons, and weasels. Rodents, rabbits, raccoons, weasels, and skunks use downed logs as hiding, feeding, and/or nesting areas.

Recent surveys of the Stillwater NWR Complex revealed the presence of seven different bat species. Most of the species surveyed roost in caves and abandoned mines in the Stillwater Range and forage over the wetlands and agricultural lands in the valley. Two of the observed species (pallid bat and hoary bat) may roost in crevices or cottonwood trees/snags along the Carson River. The most common bat found in the area was the little brown myotis (Rahn 1998).

The only small mammals trapped on Anaho Island were deer mice. Woodbury (1966) reported tracks and feces of coyote in 1966 and Refuge personnel observed coyote tracks on the island in 1996.

Alternative A: Mammal populations would be similar to those under existing conditions, except in Stillwater Marsh, where muskrat populations and populations of other marsh species would be higher (given a doubling of marsh habitat). However, because muskrat trapping would continue primarily for the purpose of providing opportunities to trappers, muskrat populations would be kept lower than potential (both at low populations and high populations). Small mammal species associated with riparian areas would continue to exist in degraded habitat conditions. The highest diversity of mammals is associated with upland desert shrub habitats, and therefore, overall diversity would largely remain the same as it exists today.

Alternative B: Mammal populations and overall diversity would be similar to that of Alternative A, except that muskrats may be somewhat impacted by lower acreage of wetland-habitat during summer, as compared to Alternative A, which would sustain relatively stable water levels. Also, small mammal populations would be enhanced in some areas, including floodplain meadow and dune habitats in Fallon NWR due to significantly reduced livestock grazing in floodplain habitat and the elimination of livestock grazing in uplands.

Alternative C: Mammals inhabiting Stillwater Marsh would be affected to the same degree they would under Alternatives A and B, except that they may benefit more under Alternative C because muskrat trapping would be limited to the protection of water control facilities and roads, thus allowing for more natural population fluctuations. Riparian species would benefit greatly under this Alternative in the long term, as compared to Alternative A. In the short term, small mammal communities in riparian areas would benefit slightly due to cattle grazing being phased out and saltcedar control being initiated. Small mammals would be further benefitted under this alternative to the extent that additional lands are protected and water is secured for the lower Carson River. Restoration of the natural composition and structure of floodplain meadow vegetation would benefit small mammals associated with this habitat, and could potentially increase the number of native species occurring on the refuge. Upland communities of small mammals would also benefit under Alternative C, as cattle grazing is phased out and Indian ricegrass and other plant communities recover.

Alternative D: Benefits that would occur under this alternative would be similar to those that would occur under Alternative C, except that muskrats and other marsh species would be adversely impacted by Alternative D. The season-low acreage of marsh habitat would slightly decline compared to existing conditions and would be considerably less than it would be under Alternative A. Also, long-term benefits in riparian areas would not be as high.

4.4.2.3 Reptiles

Under existing conditions, nine lizard species and five snake species can be observed throughout the Stillwater NWR, Fallon NWR, and Stillwater WMA. Most species are closely related to upland habitats, with some Stillwater WMA habitats providing the highest density and diversity of lizard species. Great Basin whiptail lizards, side-blotched lizards, and long-nosed leopard lizards are most common and can be observed in all upland habitat types. Great Basin collared lizards, zebra-tailed lizards, and desert horned lizards are associated with specific upland habitat types. While habitat management activities under the different alternatives would likely have little effect on lizard species, including additional lands within the boundary of Stillwater NWR would protect additional upland habitat and provide additional protection from the commercial collection of lizards. Alternatives C and D would provide the greatest amount of habitat protection through exclusion of livestock grazing. Lizard collecting would be prohibited under all alternatives.

Snakes vary in their habitat relationships, most species are associated with wetland-habitats. Wandering garter, western aquatic garter, and Great Basin gopher snakes are typically seen along shorelines. Racers and long-nosed snakes are less frequently encountered but can be observed throughout a variety of habitats. Fluctuation of shoreline habitats as anticipated under Alternatives B, C, and D could benefit garter snakes by increasing the abundance of their prey through the elevated primary production in shoreline habitats.

4.4.2.4 Amphibians

Amphibians are sensitive to water having high concentrations of trace elements and other dissolved solids. Concentrations of certain trace elements and pesticides have been shown to adversely affect amphibian populations (Maxell and Hokit 1999). Studies of local amphibian populations have found that frogs have been impacted by the high concentrations of dissolved solids entering wetlands. However, specific data pertaining to the occurrence and distribution of amphibian species, either historically or currently, are not available for the affected area. Amphibian species that occur in the area are likely affected by concentrations of total dissolved solids reported from waters in the study area.

Under existing conditions, three species of amphibians can be found on Stillwater NWR, Stillwater WMA, and Fallon NWR: leopard frogs, western spadefoot toads, and bullfrogs. At present, leopard frogs have only been observed at Stillwater Point Reservoir (where relatively fresher water occurs), spadefoot toads have been observed at Timber Lake and wetlands in the Battleground Point area (which receive water only in spill years and are dry by late summer), while bullfrogs can be seen in all permanent water in the area. No abundance estimates are available for amphibian species. Little is known about the spadefoot toad population on the lower Carson River, but given the large number of tadpoles found in some locations, it is apparent that the toads migrate to these areas during the breeding season from the areas they inhabit during the remainder of the year. Vehicle traffic in these areas has been light, but many studies have shown that higher levels of traffic can have major impacts to toad po

The introduction of bull frogs and nonnative fish species have been shown to significantly impair native frog populations in other areas (Maxell and Hokit 1999, Appendix N). Higher salinity and alkalinity of wetlands and altered hydrology can also influence native frog populations. Under existing conditions, these factors would likely continue to impair leopard frog populations. All species would be affected differently depending on which alternative was implemented, except that leopard frogs would continue to be adversely affected by introduced species, such as bullfrogs and game fish under all alternatives. Frog species would likely benefit most from permanent water management with seasonal spring pulses into wet meadow habitats while spadefoot toads would benefit more under simulation of the natural hydrology and associated drying of habitats.

Alternative A: Under this alternative, the amount of wetland-habitat in Stillwater Marsh would be nearly doubled by the completion of the water-rights acquisition program, as compared to existing conditions, and the freshness of inflow would increase substantially. This, along with increased permanent water, should benefit bullfrogs, and possibly leopard frogs. Of the alternatives, Alternative A would be most favorable to bullfrogs and least favorable to spadefoot toads. Seasonal habitats suitable for spadefoot toads may increase slightly from existing conditions with some water level fluctuation during spring months (northern parts of Stillwater Marsh, adjacent to the dunes). Spadefoot toad populations at Battleground Point would remain similar to existing as this area depends on, and will continue to rely on, spill-water for seasonal flooding. Due to the limited amount of herbicides to be used under this alternative and limited distribution of native amphibians use of herbicides under this alternative is not anticipated to adversely impact native amphibians.

Alternative B: Summer drawdown followed by fall flooding would likely provide no additional benefits over baseline and could provide for lower populations of permanent-water species, such as leopard and bullfrogs. While not documented in the core wetland area subject to water-management schedules, it is possible that summer drawdowns could slightly benefit spadefoot toads by simulating natural reproduction conditions. Due to the limited amount of herbicides to be used under this alternative and limited distribution of native amphibians use of herbicides and pesticides under this alternative is not anticipated to adversely impact native amphibians. Precautions would be taken to minimize any possible effects.

Alternative C: Spring water inflow, followed by a considerable amount of permanent water through the rest of the year, would simulate natural reproduction habitat and could provide for slightly higher populations of bullfrogs and leopard frogs than baseline. Similar to Alternative B, summer drawdown could potentially provide additional benefits for spadefoot toads with approximately one-third of refuge units drawing down until the following spring. By incorporating the lower Carson River into the Stillwater NWR, the potential exists to secure additional water for the Battleground Point wetlands, which would benefit spade-foot toads in the long term, so long as the wetlands remain seasonal. It is estimated that Alternative C would have more benefits to amphibian species than baseline. Due to the limited amount of herbicides to be used under this alternative and limited distribution of native amphibians use of herbicides and pesticides under this alternative is not anticipated to adversely impact native amphibians. Precautions would be taken to minimize any possible effects.

Alternative D: Less permanent water would be available to maintain permanent-water associated frog populations; however, at least some permanent water would remain throughout the year (approximately 5,000 acres of marsh habitat during the fall and winter). Through increased freshwater input, leopard frog populations could be higher than baseline, but it is not known how this species would respond to low fall water levels. Furthermore, filling of wetland units (peak in June) would be later than occurred naturally, which may lower the benefits that otherwise would result from a spring pulse. This could affect the potential benefits to spade-foot toads at the northern end of Stillwater Marsh where the higher amount of wetland-habitat during spring would result in more of these areas being flooded. Under this alternative, a considerable amount of Stillwater Marsh would dry through summer and fall. Herbicides would not be used under this alternative, and therefore no impacts would occur.

4.4.2.5 Fish

Twenty-nine different species of fish have been documented on Stillwater NWR, Stillwater WMA, and Fallon NWR (Appendix B). Native fish expected to occur in the wetlands include Lahontan tui chub, Lahontan speckled dace, and Lahontan red-side shiner. Tui chub are listed as a species of concern, where Carp and mosquito fish are introduced species. The tui chub population has likely decreased from pre-Newlands Project conditions due to the introduction of carp, mosquito fish, and other nonnative fish, along with the reduced acreage of wetland-habitat. Lahontan red-side shiner have been observed in the Stillwater marsh over the past several years (W. Henry, Wildlife Biologist, USFWS, personal communication, 2000), but Lahontan speckled dace has not been recorded for about 20 years.

Recent gill net surveys at the Canvasback Gun Club revealed the presence of seven different species. Carp and Sacramento black fish were most common followed by black bullheads and channel catfish. Also present were walleye and white bass. Canvasback Gun Club members stocked channel catfish and largemouth bass in Big and Little Mallard Ponds in 1996. In the Indian Lakes area, NDOW has been stocking a variety of fish species in Likes Lake, Papoose Lake, and Big Indian Lake, including rainbow trout, white bass, largemouth bass, white crappie, yellow perch, green sunfish, bluegill, black bullhead, and channel catfish. All of these species, except white crappie and bluegill, have been stocked since 1989. Rainbow trout were last stocked in 1992.

Under existing conditions, three primary fish species occur in Stillwater Marsh; Lahontan tui chub, European carp, and mosquito fish. Carp comprise the majority of the fish biomass in Stillwater Marsh, but mosquito fish and tui chub are also common to abundant. European carp displace native fish and also increase water turbidity which reduces the ability of vegetation to germinate (Robel 1961). Under stable water management, the carp population can become very large which can reduce the quality of all marsh habitats through vegetation inhibition and destruction. Water level control is the only technique currently used, although chemicals, such as Rotenone can also be applied when populations exceed maximum acceptable levels.

Mosquito fish also compete with native fish, and, because they consume insect larvae, also compete with waterbirds that feed on these larvae. However, controls to eliminate these fish would also reduce native fish populations. Mosquito fish are commonly stocked in water-delivery systems throughout the Carson Division outside the refuge to reduce mosquito populations. No mosquito-fish control is currently practiced on the refuge.

Several game fish are continuously introduced into the marsh through the conveyance of water into Stillwater Marsh, Indian Lakes, and the lower Carson River from Lahontan Reservoir. Although not nearly as plentiful as nongame fish, several species of game fish are periodically conveyed into Stillwater Marsh and into lower stretches of the Carson River, including white bass, largemouth bass, white crappie, yellow perch, green sunfish, bluegill, black bullhead, and channel catfish. At this time, wetland conditions continue to be less than optimum for most game fish.

Alternative A: Through completion of the water rights acquisition program, a 100 percent increase in wetland-habitat acreage in Stillwater Marsh would enhance fish habitat over existing conditions. Water levels would fluctuate less than they do now, creating additional permanent water habitats, which would enhance carp populations. Less fluctuation in water levels, along with a fresher marsh, would improve conditions for game fish populations. Similarly, fresher water in the marsh system would enhance habitat suitability for tui chub, but higher populations of carp, mosquito fish, and introduced game fish would adversely affect tui chub populations due to competition, altered habitat, and predation. Overall, native Lahontan tui chub would benefit over existing from implementation of this alternative; however, promoting nonnative fisheries through more stable water levels would tend to increase competition for limited resources.

Alternative B: Summer drawdown under this alternative would tend to reduce the amount of permanent water habitat through summer months and would expose fish populations to waterbird predation. This drawdown, followed by reflooding in the fall and winter, would produce higher populations of invertebrates, which are a preferred food of many fish species. This would benefit tui chub and mosquito fish as compared to Alternative A and existing conditions. Reduced permanency of water would not be sufficient to adversely impact carp, but may adversely impact game fish, as compared to Alternative A. Overall, carp populations would be maintained at lower levels than under Alternative A, primarily due to increased efforts to control them. As compared to existing conditions, game fish populations would be enhanced.

Alternative C: This alternative focuses on simulation of the natural hydrology which also produces summer drawdowns. Additional fish benefits would be provided through spring and limited fall flooding of shallow water habitats which would enhance fish foraging opportunities. Many wetland units would be drawn down during the summer. Drawdowns would continue into the fall in one-third of the wetland units and water levels would be maintained in another one-third of the units (the remaining one-third would be flooded during the fall). These drawdowns, including periodic drying of wetland units, would have the added benefit of maintaining lower populations of carp, control of which would be supplemented through limited use of chemicals. Game fish populations would also be lower than Alternative A due to periodic drying of wetland units, which would not be favorable to maintaining game fish. While a lower percentage of permanent water would be provided compared to Alternative A, tui chub would benefit from this alternative, due to the increased invertebrate populations and adverse impacts to nonnative fish species.

Alternative D: Potential effects would be similar to Alternative C except that much less permanent water would be provided on an annual basis and no chemical control would be used for carp. Due to the much lower acreage of permanent water, fish populations would be lower than those anticipated under Alternatives A and C.

4.4.2.6 Invertebrates

Three broad categories of invertebrates are considered in this section; marsh, riparian, and upland communities. Habitat responses of marsh invertebrates are complicated. Effects of water management on marsh invertebrates are influenced by life history strategies used by different invertebrate groups and the habitats where many of the invertebrates spend all or part of their lives. Life history strategies include overwintering in mudflats and emerging in spring or summer flooded habitats, migrating to summer habitats as adults, and spending their entire life cycle in permanently flooded habitat. Each alternative would have a different effect on marsh invertebrate diversity.

Recent studies within the Lahontan Valley lentic and benthic wetland zones have found the presence of invertebrate species representing at least 25 families from four separate classes including insects, crustaceans, arachnids, and mollusks (Bundy 1996, Bundy 1997). In the flowing-water habitats sampled, more families of invertebrates were found in freshwater samples (from the Carson River) than drainwater samples, with 15 families represented versus nine in drainwater. Mayflies, mosquitos, and crustaceans dominated freshwater samples while water boatman overwhelmingly dominated drainwater samples. Four different wetland communities were sampled: mud flat - alkali playa, wet meadow, emergent, and submergent. Aquatic invertebrate diversity was highest in emergent wetlands (18 families represented) and lowest in mud flat - alkali playa wetlands (11 families). Wet meadows showed the highest abundance (3,099 individuals/m^2) while mud flat - alkali playa wetlands had the lowest (500 individuals/m^2). Snails appeared to prefer deeper water while crustaceans (e.g., shrimp, water fleas) preferred intermediate to deep water. Benthic invertebrate communities were found to be high in abundance but with relatively few families represented (only eight families sampled). Samples were typically dominated by two snail families, Physidae (pond snails) and Planorbidae (orb snails). Orb snails appeared to prefer fresh moving water while pond snails showed a preference for slower, more saline water (Bundy 1997).

Under existing conditions, 25 aquatic invertebrate families have been documented in Stillwater Marsh habitats. These range throughout all habitat types with individual families showing preference for different habitats. Water level fluctuations common to the present Stillwater Marsh system may have decreased the abundance of many species as compared to estimates of pre-Newlands Project conditions, as extended droughts may have temporarily eliminated permanent-water associated populations. Over time, there has been a decreased in the abundance of many species adapted to fresher water; however, diversity of invertebrate species has likely increased through addition of nonnative plant species and a wider range of salinity levels.

An important group of wetland invertebrates in the study area is mosquitos. Within Churchill County, there are 11 mosquito species in four different genera (Table 4.19). They can be separated into those that can lay their eggs on soil and debris, and those that lay their eggs on the water. Fluctuating water levels are favorable to *Aedes* species, which lay their eggs on the soil. By keeping water at a particular level for several weeks or longer, *Aedes* mosquitoes do not develop succeeding generations. By keeping water levels constant, *Culex*, *Culiseta*, and *Anopheles* species will develop succeeding generations. *Culex tarsalis*, a standing water species, is the most abundant mosquito in the affected area, and is a known carrier of Western equine and St. Louis encephalitis, diseases that affect humans and horses. To date, there have been few cases of human and horse mosquito-borne encephalitis in Nevada (Churchill County Mosquito Abatement District, written communication, dated Sept. 1 1995). Each year, encephalitis is detected in sentinel chickens in Churchill County, but cases of encephalitis in humans are rare in the county. Generally, mosquitoes can disperse five to ten miles from where they hatch. One species found in the area has a range of more than 20 miles (ibid). Mosquitoes can be transported greater distances by the wind and can be problematic throughout Lahontan Valley during the warmer months of spring and summer.

Riparian invertebrate communities have experienced the greatest change from historic conditions. Lack of spring flows through the existing river channel and associated lack of seasonal flooding of riparian wetlands has led to changes in vegetation community structure. This change has been further exacerbated by continuous, growing season long livestock grazing and encroachment by invasive plant species, such as saltcedar. While a different set of riparian invertebrate species has adapted to these altered vegetative conditions, native species preferring fresh, moving water such as mayflies have been reduced in abundance. Reduced coverage by native willow species may have lowered habitat suitability for the Nevada viceroy, a butterfly species of special concern. The Nevada viceroy is dependent on Coyote willow, which has been impacted by saltcedar competition along both the Humboldt and Carson rivers (Herlan 1971).

Upland invertebrate communities are divided between sand dune specific species and those associated with upland shrublands (most of the Stillwater WMA). Surveys conducted on Stillwater NWR, Stillwater WMA, and Fallon NWR during 1998 revealed the presence of 12 different species of beetles. All of the widely distributed dune beetle species known from the Great Basin were found during the surveys. A newly described beetle species for the Great Basin, *Aphodius* parapyriformis, was also collected and may be endemic to the Stillwater dunes. In addition, a potentially new cricket species from the genus *Stenopelmatus* was documented. This species may also be endemic to the Stillwater dunes (Rust 1998). Another endemic species of sand-obligate beetle, *Novelsis sabulorum*, known from Sand Mountain and Blow Sand Mountains in the Walker River Basin, has been collected at the Stillwater dunes (Beal 1984 as cited by Rust 1998).

Table 4.19: Local abundance, larval presence periods, preferred habitats, preferred prey, and disease transmission potential for 11 mosquito species known to occur in Churchill County, Nevada (adapted form table provided by Mike Wargo, Churchill County Mosquito Abatement).

Species	Local Abundance	Larval Presence	Preferred Habitat	Preferred Host	Diseases Carried
Aedes campestris	Abundant	Feb-June	Alkali Ponds, Lake margins	mammals, including humans	none known
Aedes dorsalis	Common	Apr-Nov	Irrigated fields, Alkali seepage	mammals, including humans[A]	Western Equine Encephalitis (2ndary vector)
Aedes melanimon	Common	Feb-Dec	Sloughs, ditches, irrigated pastures	rabbits, cattle	Western Equine Encephalitis (2ndary vector)
Aedes nigromaculis	Common	Apr-Oct	Irrigated pastures	cattle, humans	none known
Aedes niphodopsis	Common	Feb-Apr	Alkali pools, ponds, seepages	mammals, including humans	none known
Aedes vexans	Rare	Apr-Nov	Roadside ditches, sloughs	mammals, birds	Heartworm
Culex erythrothrax	Rare	Sep-July	Pools, springs, cattails	mammals	none known
Culex peus	Rare	May-Nov	Polluted, stagnant water	birds, humans	none known
Culex tarsalis	Abundant	Apr-Dec	Irrigated fields, ditches, pools	birds, mammals	Western Equine and St. Louis Encephalitis
Anopheles freborni	Common	Apr-Oct	Lake margins, algal mats, swamps, spring pools, irrigated pastures	cattle, rabbits	Western Malaria
Culiseta inornata	Common	All Year	Irrigated fields, ditches	livestock	none known

[A] Very few reported cases in Churchill County.

Sand dune insects use the sand around the root systems of emergent vegetation as a micro habitat within the active dune. Of the 12 species of beetles collected, four are carnivores, four are detritivores (species that eat dead and decaying organisms), one is a herbivore, and three have unknown eating habits. The beetles collected can be categorized into three different groups based on their seasonal activity patterns: six species are active year-round, two species are active during the warm summer months, and one species is active during the cold winter months, three species have unknown activity patterns (Rust 1998). No inventories have been completed on upland shrub associated invertebrate communities.

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Alternative A: This alternative would result in a low amount of water level fluctuation, which would increase habitat for invertebrates favoring permanent water such as snails, mollusks, water mites, and shrimp. Conversely, only a limited amount of seasonally flooded habitat would be available for insect species which typically over-winter in dry mudflats and emerge when spring water saturates unvegetated alkali mudflats, wet meadow, and shallow emergent habitats. While this alternative would increase density of permanent-water invertebrates, less fluctuating water levels, as compared to existing conditions, would tend to reduce habitat availability for invertebrates, such as spring and summer insects, which prefer seasonal habitat.

Invertebrate communities in riparian areas and floodplain meadows along the lower Carson River would continue to be affected by low water supplies, heavy livestock grazing, and expansion of saltcedar. Some species of upland invertebrates would continue to be impacted by reduced abundance of native vegetation, such as Indian ricegrass, and altered structure of understory vegetation.

Alternative B: Similar to Alternative A, spring water level increases would not occur to any great extent (except in spill years). Therefore, spring and summer invertebrates waiting for this seasonal water before they emerge would not benefit from this alternative. Between mosquito species, several different emergence-strategies are used so that units flooded in the fall would benefit later emerging species; however, most species would not benefit. Considering an emphasis on producing moist-soil vegetation under this alternative, considerable amounts of vegetation would remain flooded during the spring, which would provide habitat for many overwintering invertebrate species. Overall, marsh invertebrate density and diversity would be higher than baseline through implementation of this alternative.

This alternative would result in similar effects on invertebrate communities in riparian and upland habitats as those discussed for Alternative A, assuming no substantial change in management of the area within the Stillwater WMA, except the following. Invertebrates associated with dune habitat in the Fallon NWR and northern end of Stillwater NWR would benefit to some degree due to addition of a full-time law enforcement officer, thus reducing impacts associated with off-road vehicle use in dune habitat, and enhanced production of native grasses and other native herbaceous plants.

Alternative C: Simulation of the natural hydrology would benefit the majority of invertebrate species; particularly those associated with spring flooded shallow water habitats. Seasonal habitats, in combination with permanent water throughout the year, would provide habitat for larval invertebrates to emerge and adults to survive through the summer. This simulation of seasonal dynamics would allow a more native diversity of invertebrates to colonize Stillwater Marsh habitats as spring water pulses would reduce salinity in wetland units, especially upper units. Although not to the extent as would occur under Alternative B, fall flooding of approximately one-third of the wetland units may provide conditions for later emerging species while providing invertebrate food (in the form of moist-soil vegetation), for spring adults. Overall, abundance and diversity of invertebrates would be higher than baseline through implementation of this alternative.

Native invertebrate communities in riparian areas and floodplain meadows along the lower Carson River would benefit from enhanced native riparian communities due to the elimination of livestock grazing and control of saltcedar. Incorporation of the lower Carson River into Stillwater NWR would create the potential to secure water for the river and wetlands near Battleground Point, which would further benefit riparian-associated invertebrates, possibly including the Nevada viceroy. Elimination of livestock grazing could adversely impact some species of butterflies associated with annual vegetation, such as mustards. As under Alternative B, invertebrates associated with dune habitat would benefit due to addition of a full-time law enforcement officer (which would reduce impacts associated with off-road vehicle use in dune habitat) and enhanced production of Indian ricegrass and other native herbaceous plants throughout the dune complex. Because Alternative C would incorporate the entire dune complex within Stillwater NWR, as opposed to Alternative B (which would only include two large parts of the system), greater, long-term protection to the system would be afforded.

Alternative D: Effects of this alternative would be similar to Alternative C except that considerably less permanent water would be provided for annual residents, such as snails and mollusks. While approximately 5,000 acres would remain during fall, there would be less permanent water available than under all other alternatives. Spring flooding, during nonspill years, would be more extreme than would occur under other alternatives, and water management would simulate more aspects of the natural hydrology. Therefore, a more natural diversity of invertebrate species would be anticipated. Overall, natural invertebrate diversity would be higher than baseline while abundance would likely be similar to baseline with a different complement of species. Benefits to riparian and upland invertebrate communities would be similar to Alternative C.

4.4.2.7 Endangered, Threatened, and Species of Special Concern

Under existing conditions, 20 endangered, threatened and species of concern may use Stillwater NWR, Stillwater WMA, and Fallon NWR. Included are mammals (six species of bats), birds (seven species), reptiles (one species), fish (three species), Invertebrates (one species), and plants (two species). Most of these broad groups have been previously covered in other sections of this chapter (and further detailed in Chapter 3), so this section will discuss how the alternatives will impact the different broad groups with some representative members used as examples.

Mammals (bats), invertebrates (Nevada viceroy), plants (Nevada orycytes and Nevada dune beardstongue), and the western burrowing owl would not be impacted to any large degree by any of the alternatives with the following exceptions. Protecting dune habitats under Alternatives C and D would benefit plants associated with the dunes, and restoration of the coyote willow plant community along riparian corridors would benefit the Nevada viceroy. The increase in available marsh habitat during the spring and summer would provide additional insects for bat foraging. Western burrowing owls could be impacted by reductions in grazing and associated low stature meadows. However, sufficient upland habitat throughout the affected area would provide considerable acreage in suitable burrowing owl habitat.

Table 4.20. Endangered, threatened, and candidate species, and species of concern in the affected area.

Common Name	Scientific Name	Federal Status[1]	Habitat[2]
Mammals			
Pygmy rabbit	*Brachylagus idahoensis*	*	up
Long-eared myotis	*Myotis evotis*	*	wet/rip/up
Fringed myotis	*Myotis thysanodes*	*	wet/rip/up
Long-legged myotis	*Myotis volans*	*	wet/rip/up
Yuma myotis	*Myotis yumanensis*	*	wet/rip/up
Pale-Townsend's big-eared bat	*Plecotus townsendii pallescens*	*	wet/rip/up
Pacific Townsend's big-eared bat	*Plecotus townsendii townsendii*	*	wet/rip/up
Birds			
Western burrowing owl	*Athene cunicularia hypugea*	*	up
Ferruginous hawk	*Buteo regalis*	*	wet/rip/up/ag
Western snowy plover	*Charadrius alexandrinus*	*	wet
Mountain plover	*Charadrius mountanus*	C	up/ag
Black tern	*Chlidonias niger*	*	wet
Yellow-billed cuckoo	*Coccyzus americanus*	*	rip
American peregrine falcon	*Falco peregrinus anatum*	*	wet/up/ag
Bald eagle	*Haliaeetus leucocephalus*	T	wet/rip/up/ag
Least bittern	*Ixobrychus exilis*	*	wet
Loggerhead shrike	*Lanius ludovicianus*	*	up/ag
Long-billed curlew	*Numenius americanus*	*	wet/up
Trumpeter swan	*Olor buccinator*	*	wet
White-faced ibis	*Plegadis chihi*	*	wet/ag
Reptiles			
Northwestern pond turtle	*Clemmys marmorata marmorate*	*	rip/wet
Fish			
Cui-ui	*Chasmistes cujus*	E	lak/str
Lahontan tui chub	*Gila bicolor obesa*	*	lak/str
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	T	str/lak
Invertebrates			
Nevada viceroy	*Limenitus archippus lahontani*	*	rip
Plants			
Nevada oryctes	*Oryctes nevadensis*	*	up
Nevada dune beard tongue	*Penstemon arenarius*	*	up

[1]Status - Federal: E = endangered, T = threatened, C = candidate species; and * = species of concern.

[2]Habitat: wet = wetland, rip = riparian, up = upland, ag = agricultural, lak - lake, str = stream.

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Bald eagles rely on riparian areas, where mature cottonwoods exist, for night roosting during winter on Stillwater NWR, Stillwater WMA, and Fallon NWR. They also frequent marsh habitats, especially where suitable perches are available. Bald eagles occur most commonly on the Stillwater NWR Complex during winter months (generally November-March), with their stay generally corresponding to high waterfowl use during this season. Therefore, bald eagles would benefit from alternatives that would provide for the long-term health of riparian areas (Alternatives C and D) and that would provide for large migratory and wintering populations of waterfowl (Alternatives A, B, and C, especially B). Bald eagles would also benefit from alternatives that would increase fish availability during winter, such as those using winter drawdowns. Human disturbance has the potential to adversely impact bald eagles in the area, especially at night roosts. Traditional roost sites would have the strongest protection under Alternatives C and D due to Stillwater NWR boundary expansion and added law enforcement. Wildlife observation trails in the vicinity of bald eagle roost sites (Alternatives C and D) would be closed during winter, and therefore would not impact bald eagles. Disturbance by hunters (especially those using boats) in the marsh area is also a potential (Appendix L), and would be lessened under Alternative C due to the higher amount of wetland-habitat that would be in sanctuary or a low density hunt zone, where disturbance impacts would be minimal. Because of their sensitivity to boats, bald eagles would benefit from Alternatives B, C, and D due to greater restrictions on boating. However, bald eagles would tend to benefit under any alternative that increases wetland-habitat acreage over existing (all alternatives).

Because peregrine falcons primarily feed on wetland-dependent birds, such as shorebirds and small ducks, during most of the year while they inhabit the Stillwater area (typically February-November), peregrine falcons could benefit most from implementation of Alternatives B or C, and possibly Alternative D. The abundance of peregrine falcons would remain sparse and human disturbance would not appear to be a factor in their use of the Stillwater Marsh.

Mountain plover and western least terns are rare visitors to the affected area. There are no reports of mountain plover on the Stillwater NWR Complex, although they have been observed on Carson Lake during winter. Because they favor barren fields, they would benefit most from Alternative A due to heavy livestock grazing pressure along the lower Carson River. Due to their low use of the refuge, they would not be markedly affected by any of the alternatives. Black terns are more common (uncommon now, but at one time were abundant). Because they nest in emergent vegetation, but are at low densities under existing conditions, all of the alternatives would produce suitable nesting habitat. However, Alternatives C and D may encourage restoration to their former abundance more so than the other two alternatives.

White-faced ibis use a variety of habitats in the affected area including deep emergent habitat for breeding, and wet meadow, shallow emergent, moist-soil, and unvegetated alkali playa habitats for foraging. They also feed in irrigated agricultural fields where invertebrates are brought to the surface during flooding. This provides an abundant food source in the Lahontan Valley. Alternatives that would optimize a complex of deep emergent habitat (Alternative C) and shallowly flooded foraging habitats (Alternatives B, C, and D) would most benefit white-faced ibis. The best alternative for this species would be Alternative C related to its combination of the previously mentioned habitats, combined with availability of fall foraging habitats for migratory

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populations not breeding at the Stillwater Marsh. Boating restrictions and closure of wetland areas to off-road hiking would benefit breeding ibis under Alternatives B, C, and D.

Northwestern pond turtles have only been observed along the Carson River, upriver of the Stillwater WMA. Alternatives C and D would provide the most potential for restoring habitat for Northwestern pond turtles by encompassing the lower Carson River within the boundary of Stillwater NWR, which would allow for the future potential of securing water for this part of the river. Furthermore, riparian restoration under Alternatives C and D, and the associated control of saltcedar would tend to provide fresher water to the system and increase shallow groundwater availability. Annual water consumption by saltcedar is estimated at 1.4 to 10.4 acre-feet/acre (USBOR 1992).

Lahontan tui chub populations in the Stillwater Marsh system were previously covered in the fish section of this chapter. Alternatives B and C are thought to provide the best habitat conditions for Lahontan Tui chub.

The ongoing water-rights acquisition program for Lahontan Valley wetlands, the same under all alternatives, will continue to reduce Truckee River diversions (USFWS 1996a), thereby increasing lower Truckee River flows. The benefits of this program to cui-ui would be highest under Alternatives C and D (especially D), somewhat lower under Alternative A, and lowest under Alternative B. Under Alternative A, the average number of cui-ui produced each year would increase from estimated existing conditions by about 43 percent and the number of adult female cui-ui at the end of the 95-year simulation period would increase over existing conditions by about 75 percent (Table 4.21). The number of spawning years would remain at an estimated 75 years out of 95 years. These changes are primarily attributable to reductions in Truckee River diversions as more water rights are acquired for Lahontan Valley wetlands (USFWS 1996a).

Table 4.21. Potential effects of alternative water delivery schedules on several cui-ui parameters, based on Below Lahontan Reservoir Model results.

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
No. of Cui-ui Spawning Years	75	75	75	75	75
Ave. No. of Young Produced/Year	63,035,600	89,843,620	90,396,740	94,009,760	98,158,460
Ending No. of Adult Female cui-ui	692,200	1,214,500	1,209,400	1,274,100	1,365,261

Source: Below Lahontan Reservoir Model results, U.S. Bureau of Reclamation.

Under Alternatives C and D, Truckee River diversions to the Newlands Project decline slightly more than they would under Alternative A (Table 4.6), which would contribute toward a greater increase in the average number of cui-ui produced each year, as compared to the increases estimated for Alternative A (Table 4.21). The number of adult female cui-ui at the end of the 95-year simulation period would increase over existing conditions by an estimated 84 percent and 97 percent increase, respectively for Alternatives C and D, as compared to the 75 percent increase estimated for Alternative A (Table 4.21). Effects of Alternatives C and D, as compared

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to Alternative A, would not be anticipated to worsen in drought years, and no changes are estimated for the number or frequency of spawning years.

The increases over existing conditions in the number of adult female cui-ui at the end of the 95-year simulation period and the average number of cui-ui produced each year under Alternative B would be comparable to that estimated for Alternative A, although the percent increase in the number of adult females would possibly be slightly lower and the percent increase in the average number of young produced would be slightly higher. Mechanisms affecting lower Truckee River flows are described in Sections 4.2.2.7 Derby Dam and Truckee Canal and 4.2.3 Lower Truckee River and Pyramid Lake.

Similar to cui-ui, changes in the seasonal delivery pattern at Stillwater NWR could potentially have slight effects on Lahontan Cutthroat trout in the Truckee River and Pyramid Lake. The ongoing water-rights acquisition program for Lahontan Valley wetlands, the same under all alternatives, will continue to reduce Truckee River diversions, thereby increasing lower Truckee River flows. The benefits of this program would be highest under Alternatives C and D and lowest under Alternatives A and B.

Buchanan (1987, as cited in USFWS 1995) estimated that it would take 478,500 acre-feet/year of water to provide suitable spring spawning habitat for Lahontan cutthroat trout in the lower Truckee River. This volume of flow would be needed nearly on nearly an annual basis. Completion of the water-rights acquisition program for Lahontan Valley wetlands (USFWS 1996a), cumulative with Adjusted OCAP (USBOR 1997), would result in an estimated long-term average of 480,500 acre-feet/year of water flowing into Pyramid Lake. As a consequence of additional reductions in Truckee River diversions resulting from implementation of Alternatives B, C, or D, lower Truckee River flow volumes into Pyramid Lake would increase further to long-term estimates of 496,140, 497,210, or 498,140 acre-feet/year, respectively. Flows of at least 478,500 acre-feet/year would be anticipated in most years.

The most critical period for Lahontan cutthroat trout, with respect to small changes in lower Truckee River flows is July-September followed by October-December, which are the periods of lowest water flow in the Truckee River. Even small changes in river flow at these times could affect trout populations. Under Alternative A, flow in the lower Truckee River would increase over existing conditions by an estimated 6.4 percent (an increase of about 7,300 acre-feet) during the period July-December (Table 4.22). Under Alternative B, there would be an estimated slight increase during July-September, but the overall change would be an estimated 5.6 percent increase over existing conditions. Over the long term, the estimated increase under Alternative B would be an estimated 1,000 acre-feet less than the 7,300 acre-feet estimated increase for Alternative A. Lower Truckee River flows during July-September and October-December would increase more under Alternatives C and D than they would under Alternative A. Lower Truckee River flows, under Alternatives C and D, would increase over existing conditions by an estimated 8.9 and 11.1 percent, respectively, compared to the 6.4 percent increase estimated for Alternative A. These alternatives would represent increases in lower Truckee River flows of 2,800 acre-feet and 5,300 acre-feet, respectively, over the 7,300 acre-feet increase estimated for Alternative A.

Table 4.22. Potential effects of alternative water delivery schedules on seasonal lower Truckee River flows (shown in acre-feet), as indexed by Derby Releases, based on Below Lahontan Reservoir Model results.

	Existing	(No Action) Altern. A	Altern. B	Altern. C	Altern. D
January-March	139,590	142,720	142,530	142,260	143,350
April-June	222,660	225,740	226,280	223,930	223,540
July-September	39,560	41,120	41,360	42,260	41,960
October-December	73,830	79,550	78,370	81,210	84,030
Annual	475,640	489,130	488,550	489,660	492,880

Source: Below Lahontan Reservoir Model results, U.S. Bureau of Reclamation.

As a consequence of implementing Alternative C, the long-term average flow volume of the lower Truckee River during July-September would increase from an estimated 39,560 acre-feet (existing conditions) to 42,260 acre-feet during this period, a 7 percent increase (Table 4.22). As compared to Alternative A, this would represent a 3 percent increase (from 41,120 to 42,260 acre-feet). October-December flows would also increase from an estimated 73,830 acre-feet (existing conditions) to an estimated 81,210 acre-feet, a 10 percent increase (or, a 2 percent increase over Alternative A). Lower Truckee River flows during April-June would increase slightly (0.6 percent) from an estimated 222,660 acre-feet (existing conditions) to an estimated 223,930 acre-feet. The slight changes in lower Truckee River flows during January-June are not of concern due to the high flows at this time of year. Mechanisms affecting lower Truckee River flows are described in Sections 4.2.2.7 Derby Dam and Truckee Canal and 4.2.3 Lower Truckee River and Pyramid Lake.

4.4.2.8 Fish and Wildlife Toxicity

As indicated in Section 3.9 (Environmental Contaminants), dissolved solids and several trace elements have been identified at potentially toxic concentrations in water, sediment, or biological tissues. A reconnaissance investigation of wetlands in and near Stillwater NWR was initiated in 1986 to determine if agricultural drainage had caused, or had the potential to cause, adverse effects to human health, fish and wildlife, or affect the suitability of water for beneficial uses (Hoffman et al. 1990). Water in some areas affected by agricultural drainage contained concentrations of arsenic, boron, dissolved solids, sodium, and un-ionized ammonia in excess of baseline conditions or Federal and State criteria for the protection of aquatic life or the propagation of wildlife. Sediment from some affected wetlands contained elevated levels of arsenic, lithium, mercury, molybdenum, and zinc. Additionally, concentrations of arsenic, boron,

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copper, mercury, selenium, and zinc in biological tissues collected from some affected wetlands exceeded levels associated with adverse biological effects in other studies. This study concluded that arsenic, boron, mercury, and selenium were of primary concern to human health and fish and wildlife in and near Stillwater NWR. Subsequent investigations have generally supported the findings of the reconnaissance investigation (Lico, 1992; Hallock and Hallock, 1993, Tuttle et al. 1996; Lico and Pennington 1997).

Pesticides are also a concern in the water supply to the Refuge. Previous investigations have examined occurrence of historic and current pesticides in water and sediment. Hoffman et al. (1990) detected organochlorine compounds in sediments collected from wetlands of Stillwater NWR and surrounding areas. Of greatest concern was lindane in normalized concentrations which exceeded the EPA's sediment quality criteria in three samples. Less persistent pesticides were not examined in this study. In a survey of water chemistry and contaminant loads in drains in the Carson Division of the Newlands Project, Lico and Pennington (1997) detected a variety of pesticides in water samples. However, concentrations were generally lower than existing standards or concentrations associated with toxicity. Because of the low persistence and sporadic use of pesticides currently used in agriculture, characterization of pesticide in the wetland water supply is difficult. Sampling should coincide with actual application of pesticides to agricultural fields or irrigation canals. Additional research is needed to more fully characterize pesticide concerns.

Changes in the wetland water supply and wetland management practices will affect the concentration and load of dissolved solids, trace elements, and possibly pesticides entering wetlands and concentrations in at least some of the wetlands within the Stillwater Marsh complex. These changes may affect fish and wildlife exposure to the contaminants. Under all alternatives, the increased inflow of Carson River, water as authorized under the water rights acquisition program, is expected to generally reduce concentrations of total dissolved solids and trace elements associated with agricultural drainwater (i.e., arsenic, boron, molybdenum, and selenium) throughout most of the wetlands within the Stillwater Marsh complex. However, because of the continued loading of natural and agricultural-induced dissolved solids in water supplies coupled with evaporative concentration of dissolved solids in wetlands, concerns with total dissolved solids and these trace elements will not be eliminated. However, difference in dissolved solids loading to wetlands under some alternatives may result in a difference in contaminant exposure and effects. Elevated aluminum concentrations are pervasive throughout the Lahontan Valley. Changes in the wetland water supply will likely have little effect on aluminum availability and concerns with aluminum are expected to be similar under all alternatives. Similarly, mercury is elevated in sediment in most wetlands within Stillwater Marsh. Exposure of fish and wildlife to mercury is expected to continue under all alternatives. However, differences in wetland management practices, such as periodic flushing and wetland desiccation, may affect mercury in biological communities. Therefore, fish and wildlife exposure to, and effects from mercury may differ under some of the alternatives. Because all alternatives rely on agricultural drainage water, concerns with pesticides are expected to be similar under all alternatives.

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Alternative A: As indicated under Section 4.6.3. (Flushing Action and Wetland Water Chemistry), groundwater may be used to supplement water supplies to Stillwater NWR. The use of poor-quality groundwater may increase the loading of dissolved solids and trace elements, such as arsenic, boron, molybdenum, and selenium, to the Refuge. Increased loading may exacerbate problems with fish and wildlife toxicity related to these contaminants.

Alternative B: Fish and wildlife exposure to environmental contaminants would be expected to be generally similar to Alternative A. A farming program on the refuge would additionally involve the use of herbicides in some cases. However, measures would be taken to lessen impacts of pesticides through integrated pest management.

Alternative C: Under this alternative, concentrations of trace elements associated with agricultural drainwater would be expected to be lower in wetland higher on the hydrologic gradient. Therefore, exposure to, and effects from these contaminants would be expected to be lower in these wetlands. However, mercury may be mobilized from bottom and bank sediments during floods in the Carson River basin. Therefore, the use of water spilled from Lahontan Reservoir during flooding may increase mercury loading to the refuge, which may exacerbate concerns with mercury. A farming program on the refuge would additionally involve the use of herbicides in some cases. However, measures would be taken to lessen impacts of pesticides through integrated pest management.

Alternative D: Fish and wildlife exposure to environmental contaminants would be expected to be generally similar to Alternative C.

Measures to Lessen Effects of Environmental Contaminants

Under all alternatives, no adverse impacts above baseline conditions are expected. However, additional measures could be implemented to minimize the potential contaminant-related impacts to fish and wildlife. Because of uncertainties in the dynamics of contaminants in this shallow marsh system, continued monitoring has been recommended. It is anticipated that contaminant concentrations in water, sediment, and biological tissues will be periodically assessed. If monitoring demonstrates the continuance of impacts, additional contaminant reduction measures will be evaluated.

As indicated under Section 4.3.3.4, measures recommended by the Department of the Interior's National Irrigation Water Quality Program (USDI 1985) to improve drainwater chemistry should reduce the adverse effects associated with use of drainwater for wetlands. Again, implementation of such measures is recommended.

Mercury appears to represent the greatest contaminant threat to fish, wildlife, and their habitat in the wetlands of Stillwater NWR. Because of mercury contamination, the Carson River to, and including, Stillwater NWR, is on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund). The U.S. Environmental Protection Agency, with assistance from the U.S. Geological Survey and the

Service, are continuing to investigate measures to reduce the impacts of mercury. Remedial measures may be implemented if and when they are identified.

4.4.3 Biotic Processes

In addition to the diversity of fish, wildlife, plants and their habitats (addressed above), biological diversity also includes the diversity of biotic processes. Some of the more prominent natural biotic processes in the Stillwater area include vegetative succession, herbivory (including grazing and browsing), production, predation, mortality, and nest loss. Many of these have been addressed earlier.

Alternatives A and B: Under baseline conditions, several biotic processes would continue to be outside the scope of naturalness, including grazing rates by large ungulates (i.e., cattle), low recruitment of certain species (e.g., leopard frogs), and possibly nest loss. Although nest loss due to flooding may be somewhat lower under baseline conditions, as compared to natural conditions, nest loss due to depredation may be higher under Alternative A. Depredation of nests may be lower than natural under Alternative B due to more emphasis on predator control. Whether overall nest loss would be higher or lower than natural conditions is not clear.

Disturbances to wildlife (e.g., disturbances causing flushing from nests, increased alert behavior, increased flying time, changes in feeding patterns, etc.) due to human activity would continue to be elevated as compared to natural conditions.

Alternative C: Under these alternatives, herbivory rates and the distribution of herbivory would be closer to natural herbivory rates than under Alternative A due to the exclusion of cattle grazing from riparian areas and uplands, and the reduction in other areas. Nest loss due to flooding would be similar to Alternative A. Although the timing of water deliveries could increase the risk of nest flooding, the larger water control structures would allow more water to pass through the marsh without raising water levels, this would be difficult to do with the existing infrastructure. A limited, or lack of a predator control program would result in similar nest loss rates as Alternative A, except that restored wet meadow and floodplain meadow habitat and lack of cattle grazing in these areas would enhance nest success of some species. Furthermore, taking down perches used by ravens and other techniques would act to reduce depredation of rates.

Recruitment and survival of leopard frogs and other wildlife would likely continue to be low unless a control technique for bullfrogs (or other competitors) is developed. Within greater amounts of habitat in areas protected from high levels of human disturbance, restrictions on boats, and fewer roads, disturbances due to human activity would be lessened.

Alternative D: Effects on biotic processes would be similar to those of Alternative C, except that nest loss due to flooding would be substantially higher under Alternative D.

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4.5 RECREATIONAL OPPORTUNITIES

Most outdoor recreation in the study area occurs on public lands that are under the jurisdiction of the BLM, Bureau of Reclamation, and the Service, and State lands administered by the Nevada Division of State Parks and Nevada Division of Wildlife. Stillwater NWR and Carson Lake are the main structured recreational use areas in the Lahontan Valley. Unstructured recreational use also occurs at Newlands Project regulating reservoirs, Soda Lakes, Stillwater WMA, Fallon NWR, along the Carson River, and in the Carson Sink.

Wetland-habitat at Stillwater NWR, Stillwater WMA, and Fallon NWR offer opportunities for waterfowl hunting, wildlife observation, boating, and sightseeing. Some fishing occurs in these areas when water conditions are conducive to sustaining game fish populations, but a Nevada State Health Advisory has been issued cautioning against the consumption of fish in the Lahontan Valley. Wetland areas that provide opportunities for recreational use include Stillwater NWR, Stillwater WMA, Fallon NWR, and Carson Lake. Most available data relate to recreational use at Stillwater NWR, Stillwater WMA, and in Churchill County.

Although Carson Lake is a Federal property, it has been operated jointly by TCID and NDOW for the past 68 years. Access to the area is controlled by the Greenhead Club, a private gun club operating the area under a joint agreement with TCID and NDOW. The public is allowed access into the Carson Lake wetlands but the Greenhead Club continues to monitor and regulate use of the area. Current recreational use at Carson Lake wetlands is predominately waterfowl hunting. Pursuant to Public Law 101-618, the Secretary is authorized to transfer Carson Lake to the State of Nevada, and it is anticipated that the area will be transferred, managed and operated for wildlife by Nevada Division of Wildlife in the near future.

There are a number of other private gun clubs that own, or have exclusive access to, wetland areas used primarily for waterfowl hunting. The Canvasback Gun Club (Stillwater Farms), which is located on private lands within the Stillwater NWR boundary, is the largest of these gun clubs.

Newlands Project regulating reservoirs include Harmon, Sheckler, S-Line/Ole's Pond, Old River, Sagouspe, and Indian Lakes. Recreational use of the reservoirs is limited by water availability. These reservoirs are small (400 to 1,000 acres) and are managed as part of the Newlands Project. Recreation in these areas is a secondary use not specifically authorized as a Newlands Project purpose. Use of these reservoirs is generally unregulated, and people hunt, fish, boat, observe wildlife, hike, conduct dog trials, and operate radio-controlled boats and planes.

An average of 34,000 people visited Fallon and Stillwater NWRs and Stillwater WMA each year during the period of 1972-1998, ranging from 17,000 to nearly 50,000 per year.

The riparian and desert shrub communities of the study area are conducive to activities, such as dove, quail, coyote, jackrabbit, and turkey hunting. They also provide excellent hiking and

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wildlife observation opportunities. These upland areas are found throughout Stillwater WMA, as well as Fallon and Stillwater NWRs. Present use is not monitored and restrictions are few.

The Truckee River flows into Pyramid Lake, which is 20 miles northwest of Fernley. Distinctive geological tufa formations and the contrasting beautiful blue of the water, abundant wildlife, and two islands, make this area a popular destination for photographers, wildlife observers, fishing enthusiasts and sightseers. Anaho Island NWR, one of the two islands on the lake, is the 248-acre host to one of the largest breeding colonies of American white pelicans in the United States. The lake holds a unique population of Lahontan cutthroat trout and the endangered cui-ui. Pyramid Lake management falls under the jurisdiction of the Pyramid Lake Paiute Tribe and visitors are required to purchase day-use, camping or seasonal permits.

4.5.1 Hunting

With the exception of Alternative D, there would be more wetland-habitat available to hunters under all of the alternatives by the time the water-rights acquisition program is completed. Furthermore, there would be much more consistency in available wetland-habitat acreage from year to year. In the past, the amount of wetland-habitat available for hunting has varied tremendously over time. Even during the period when waterfowl hunting was at a high in the Lahontan Valley (1950s through the 1970s), the number of hunters in any given year varied markedly. In the late 1950s, the number of visits to Stillwater NWR was around 10,000, but it dropped well below 1,000 during the drought in the early 1960s, but it rebounded again later that decade and exceeded 10,000 visits in the 1971-1972 hunting season. Then numbers dropped to the low thousands in the mid 1970s to rebound again to over 1[illegible],000 visits in the 1979-1980 season. In the late 1980s and early 1990s, hunter visits reached an all-time low, and no hunting was available during one especially dry year. The amount of wetland-habitat open to hunting has ranged from several hundred acres in a number of years (and zero in one year) up to more than 12,000 acres in exceptionally high-water years.

According to output of the Below Lahontan Reservoir model, water shortages would only occur in nine out of 95 years which, along with water-rights for Stillwater NWR wetlands, means that a near-average amount of wetland-habitat (the actual amount varying by alternative) or more would be available in an estimated 88 of 95 years (assuming climatic conditions over the past 95 years). In 24 of these years, there could be substantially more wetland habitat than the average amount due to precautionary releases and spills from Lahontan Reservoir. The estimated acreage of wetland-habitat open to hunting under each alternative is presented below.

Alternative A. Under Alternative A, baseline conditions, hunting would continue to be the priority public-use on Stillwater NWR, Stillwater WMA, and Fallon NWR. Hunting opportunities would increase due to the doubling of the amount of wetland-habitat in Stillwater Marsh available to waterfowl hunters in nonspill years, as compared to existing conditions. Given the volume of water rights that have been acquired to date, an estimated 4,100 acres of wetland-habitat would be open to hunting on Stillwater NWR in full-allocation, nonspill years. At the completion of the water-rights acquisition program, an estimated average of 8,900 acres of wetland-habitat would be available for hunting in nonspill years. Assuming 15,000 acres of wetland-habitat during a spill-year, about 10,500 acres of wetland-habitat would be open for hunting. Factoring in shortage years, up to 9,000 acres of wetland-habitat could be open to hunting in 6 out of 10 years, and up to 10,000 or more acres in another 2-3 out of 10 years on average.

Based on the number of hunters using Stillwater NWR during the 1998-1999 hunting season, hunter densities within an area of 8,900 acres would approximate one hunter per 350 acres during the week and one hunter per 150 acres on weekends. These densities represent the minimum anticipated under Alternative A. An increase in density would be expected due to lower wetland-acreages during nonspill years until the water-rights acquisition program is completed. As an illustration of densities that can occur under the existing program, densities of hunters in the 1971 season, when there were 12,850 acres of huntable habitat, approached one hunter for every 35 acres of habitat on many weekends and opening weekend it was one hunter per 8.6 acres. Although hunter numbers will likely not approach those of the early 1970s, numbers will probably continue to increase as wetland-habitat acreage increases and as the population increases in the nearby cities of Fallon, Reno, and Carson City and as more hunters from adjacent states continue to discover Stillwater NWR. Additional hunting opportunities would be provided when the terminal delta of the Carson River (Battleground Point wetlands) contains water, although this is expected to only happen on rare occasions. By continuing to not impose hunter-density limits and boating regulations for safety purposes, hunter safety could be of concern in years of lower wetland acreage, and possibly at higher acreages if hunter numbers increase markedly.

The riparian and upland habitats of the Stillwater WMA would continue to provide hunters the opportunity to hunt for coyotes, black-tailed jack rabbits, mourning doves, California quail, mule deer, and turkeys along the lower Carson River and D-Line Canal, and other parts of Stillwater WMA. Density of these hunters is assumed to be less than that in the marsh, due to the expanse of available habitat found in Stillwater WMA. These hunters have not been monitored except by casual observation, and an estimate of the actual density has not been determined. The number of hunters using these areas is not expected to increase to any great extent beyond what they have been in the recent past because no additional opportunities will be provided or facilitated.

Alternative B: This alternative would offer the highest acreage of huntable waterfowl habitat of all the alternatives. As compared to existing conditions, the amount of huntable habitat in a full-allocation, nonspill year would more than double over the next 15-20, or more years when the water-rights acquisition program is completed (an estimated 9,500 acres). Hunter density would be slightly lower than under Alternative A. Assuming 15,000 acres of wetland-habitat during October-December in a spill year, about 10,500 acres would be open to hunting, similar to Alternative A. Factoring in shortage years, 9,000-10,000 or more acres of wetland-habitat could be open to hunting in 8-9 out of 10 years on average. Densities of hunters would not be substantially affected under this alternative, except that by the end of the season, densities could decline as wetland-habitat acres increase. The wetlands in Fallon NWR would infrequently provide additional waterfowl hunting opportunities. When a sufficient amount of wetland-habitat exists during the hunting season, the area south of the existing dike would be open to hunting, with the northernmost portion of the wetland-habitat acting as sanctuary.

The entire Stillwater NWR would be closed to hunting if the total amount of wetland-habitat were to fall below 3,000 acres, which could possibly displace hunters to alternate hunt areas, such as Carson Lake and Humboldt Sink. Construction of an all-weather tour route could result in more people hunting in Stillwater Marsh during and immediately following heavy rains or snows, which would increase the range of experiences and opportunities available. The increase in opportunity would not significantly increase density in these areas because there would be more huntable acreage available under this alternative as compared to Alternative A. Additional waterfowl and upland game hunting opportunities on lands administered by the Service would be fewer than under Alternative A, due to Stillwater WMA areas, such as the lower Carson River, Indian Lakes area, and D-Line Canal not being included under Alternative B. However, it is anticipated that opportunities currently taking place in these areas would not be affected greatly by implementation of Alternative B because hunters would likely still have the opportunity to hunt in these areas.

With more stringent boating regulations, hunter density limits, and increased law enforcement, the satisfaction of the hunting experiences for some would decrease slightly, and safety would improve, from conditions in Alternative A. Under this alternative, hunters using airboats (an estimated 1 percent during the 1999-2000 season; Chaney 2000) could be displaced. This could result in hunters seeking opportunities to use their airboats in other areas, such as Carson Lake and Humboldt Sink. Due to the low numbers of hunters using airboats, density of hunters in these other areas are not expected to increase measurably. Alternately, with the exclusion of airboats from the marsh, these hunters could opt to change to other means of transportation and continue to use Stillwater NWR and have no appreciable effect on the hunting in other areas in Lahontan Valley.

Alternative C, Option 1: Hunting opportunities in Stillwater Marsh under this alternative would increase by a least 10 percent as compared to existing conditions in a full-allocation, nonspill year, but there could be as much as a 20 percent increase based on the flexibility in water management (Section 3.4.C.4.1.1.1) under the ongoing water-rights acquisition program. Reasons for the lower amount of increase, as compared to Alternatives A and B include less wetland-habitat in the fall and winter than under Alternatives A and B, and the addition of a non-hunted tour loop. Several small units would be converted from sanctuary to a wildlife observation/environmental education area, and two formerly huntable wetland units would be converted to sanctuary. Assuming mid-points in the seasonal delivery pattern (Section 3.4.C.4.1.1.1), an estimated average of 10,500 acres of wetland-habitat would exist in Stillwater Marsh during the hunting season, of which an estimated 4,500 acres would be available for hunting. This could result in slightly densities of hunters as compared to Alternative A (e.g., one hunter per 75 acres on an "average" weekend versus one per 150 acres, based on 1998-1999 hunter numbers). Assuming 15,000 acres of wetland-habitat during a spill year, about 7,000 acres would be open to hunting. Factoring in shortage years, an estimated 4,500-5,000 acres of wetland-habitat could be open to hunting in 6 out of 10 years, and up to 7,000 or more acres in another 2-3 out of 10 years on average. The amount of wetland-habitat available for hunting during a nonspill year followed by a spill year would be higher than the amount indicated above.

Opportunities for hunting in West Marsh Lake and Lead Lake, a traditional hunt area for some, would no longer exist under this alternative. This could affect a combined total of about 18-25 percent of hunters using Stillwater Marsh, based on data collected on hunter use during the 1998-1999 and 1999-2000 seasons (Santy 1999, Chaney 2000). More limited boat use (due to the prohibition of their use on several units and the prohibition of airboats) would decrease the quality of the experience for some hunters, but would add to the quality of the experience for others. Some hunters may be displaced due to more stringent boating regulations to be adopted under this alternative, or they may be influenced to change or buy additional equipment. An estimated 1 percent of hunters used airboats during the 199-2000 season (Chaney 2000), and therefore a small number of hunters would be affected by the exclusion of airboats. Opportunities for upland game bird hunting would be slightly lower than under Alternative A due to the Carson River below Timber Lake not being included in the hunt area. However, upland hunting along the lower Carson River, and D-Line Canal within the hunt area would improve over the long term, as compared to Alternative A, due to increased acres of riparian habitat to be included in Stillwater NWR (future acquisitions) and the restoration of riparian habitat. Data are not available for hunter density in the riparian and upland areas.

Alternative C, Option 2: This alternative would provide more hunting opportunities than under Option 1. As compared to existing conditions, the amount of huntable habitat would increase by at least an estimated 46 percent in nonspill years by the time the water-rights acquisition program is completed, and could increase by as much as about 80 percent under this option. The amount of huntable habitat would increase more than it would under Option 1 of Alternative C, but not to the extent that it would under Alternatives A and B. Assuming mid-points in the seasonal delivery pattern (Section 3.4.C.4.1.1.1), an estimated average of 10,500 acres of wetland-habitat would exist in Stillwater Marsh during the hunting season, of which an estimated 6,000 acres would be available for hunting (an increase of 46 percent over existing conditions). This could result in slightly densities of hunters as compared to Alternative A (e.g., one hunter per 120 acres on an "average" weekend versus one per 150 acres, based on 1998-1999 hunter numbers). Assuming 15,000 acres of wetland-habitat during a spill year, about 10,500 acres would be open to hunting, similar to Alternatives A and B. Factoring in shortage years, an estimated 6,000-7,000 acres of wetland-habitat could be open to hunting in 6 out of 10 years, and up to 10,000 or more acres in another 2-3 out of 10 years on average. The amount of wetland-habitat available for hunting during a nonspill year followed by a spill year would be higher than the amount indicated above.

Under this option, none of the area now within the hunt area would be converted to sanctuary and the addition of a walk-in-only hunt zone within the existing hunt area would increase opportunities for this type of hunting experience. Additional road closures would increase quality of the hunt for some by providing the opportunity for a more "primitive" hunt in nonboating wetland units, thus broadening the opportunity for a wide spectrum of hunters. Conversely, it would provide for fewer opportunities for hunters wanting to drive or boat to all hunting sites. Converting West Marsh and Swan Lakes to low-density hunt units where only walk-in hunters would be permitted, could affect the hunters that used West Marsh and Swan Lake. An estimated 9 percent of total number of hunters in the 1998-1999 season used West Marsh and Swan Lake (Santy 1999). This figure went up somewhat during the 1999-2000 season, when an estimated 19 percent (Chaney 2000). Assuming 20 percent of hunters used boats in these units (based on a refuge-wide average), an estimated 2-4 percent of the hunters using Stillwater NWR during the last two season could be affected by converting West Marsh and Swan Lake to a walk-in-only hunt area. Until three years ago, and in most years in the past, West Marsh has not had water in it during the hunting season and therefore has supported few hunters. All other factors (boating, upland hunting) would be similar to Option 1. A small number of hunters would be affected by the exclusion of airboats, as noted under Alternatives B and Option 1 of Alternative C

Alternative D: Hunting opportunities under Alternative D would likely not increase from existing conditions to any large degree primarily due to differences in water management, but also because of the minimum sanctuary size of 4,000 acres and the wetland-habitat to be maintained in the general public use (nonhunted) area. With the majority of water delivered during spring and the acreage threshold imposed, huntable habitat would be minimal in many years and it may not reach supportable acreages during many other years because wetland-habitat acreage during full-allocation, nonspill years at the completion of the water-rights acquisition program would only reach an estimated total wetland-habitat acreage of approximately 5,800 acres. Assuming 5,000 acres would be available for the sanctuary and general public use area, only 800 acres would be available for hunting. Acreage would be available for hunting during nonspill years. Assuming 15,000 acres of wetland-habitat during a spill year, about 6,000 acres would be open to hunting, similar to Option 1 of Alternatives C. Opportunities for upland game hunting would be less than there would be under Alternative A because wildlife observation trails would be established in the riparian zones along the Carson River near the property formerly owned by the Alves family, prompting the need to separate the user groups for reasons of health and safety. Boating opportunities would include those boats either without motors or with electric motors in open units, thus diminishing the experience for people that use motorized boats (up to 20 percent of hunters could be affected). However, in years when adequate habitat is available, the experience would be enhanced for hunters wanting a more primitive experience. All other components of the hunting program would be run as in Option 1.

Mitigation Measures

Although hunting opportunities would increase as compared to existing conditions, implementing Alternative C or D could result in fewer hunting opportunities as compared to baseline conditions, especially if Alternative D or Option 1 of Alternative C were implemented. Several of the possible mitigation measures that could lessen the impacts of implementing a hunt program that are consistent with Public Law 101-618, other laws, and Service policy have already been built into the two options of Alternative C. Establishment of a limited goose hunt (permit system) could be implemented to offset the lower level of wetland-habitat acreage that would be available under Alternative C as compared to baseline conditions. Another possibility to mitigate impacts of reduced huntable habitat under Option 1 of Alternative C would be to provide half-day hunts or alternative days open for hunting with days open for other uses, rather than reducing the size of the hunt area to provide an area for other, nonconsumptive uses. A "sliding" open area could be implemented. As waterfowl use declines during the season, the amount of sanctuary could be reduced, allowing additional acres to be hunted. Although there are numerous possibilities to mitigate adverse impacts to hunting opportunities, some of these would result in unacceptable biological impacts, would be complicated to administer or enforce, or would result in another alternative such as Alternative A or B. Mitigation measures that would reduce impacts to hunting opportunities to the greatest degree would be a further increase in fall water deliveries and a reduction in the minimum amount of sanctuary to be maintained. These measures are evaluated under Alternatives A and B.

Monitoring would be a critical part of Alternatives C and D. As more information becomes available on the relationships between hunting and related activities and the achievement of refuge purposes and goals, the hunting program could be adjusted. This is would be a long-term process.

4.5.2 Environmental Education and Interpretation

Alternative A: This alternative offers a wide variety of habitats available for exploration and research. Current conditions provide touring opportunities for an average of 17 groups of approximately 40 people per tour per year. These tours occurred in 1998 during January-November, with April and May being the favored months. Under this alternative, numbers should remain similar due to lack of enhanced existing facilities for environmental education and interpretation. The current practice of taking groups into the hunt area during hunting season would probably continue because it would be the only area open to the public at that time, but some teachers and group leaders would continue not to visit the historic marsh when they learn the available viewing areas are in the hunt area. This would inhibit increased use of the area during the fall by visitors. Teachers would probably seek an area with more amenities. The mobile interpretation program, such as presentations to schools and organizations, would continue to be improved and enhanced as warranted, but on-site programs would continue to barely provide for the needs of the local schools due to lack of interpretive facilities and sites.

Alternative B: Alternative B would provide additional opportunities for environmental education and interpretation with the construction of a comprehensive visitor and environmental education center. The center would provide services heretofore missing from the Stillwater NWR experience, such as restrooms, learning center, museum dioramas, and observation and study opportunities. This would afford teachers of younger children, grades one through three, an opportunity they have previously foregone due to lack of restroom facilities. Visitation would increase due to the availability of an environmental education site removed from the hunting public (gaining those who declined to tour at this time during the current program). On-site educational programs, particularly trips into the historic marsh, which would be allowed only during the spring in order to avoid conflicts with the hunting public, would stagnate a portion of the program. The mobile interpretation program would continue as in Alternative A.

Alternative C: The visitor facility provided in this alternative would provide similar opportunities as described in Alternative B. The environmental education program would be increased under Options 1 and 2 due to the addition of a site near the historic marsh to conduct activities and to afford more comfort for the public (addition of restroom/comfort facilities). Under Alternative C, the addition of the tour loop through what is now sanctuary and creation of wetland-habitat along Hunter Road would allow visitors to see the marsh as soon as they enter the refuge. Retaining the lands within the present Stillwater WMA would present opportunities for studying local species of reptiles and amphibians by adding the vegetated dune habitat to Stillwater NWR. Interpretation opportunities would be higher than under Alternative A because interpretative facilities would be developed and along the Carson River corridor in the Timber Lake area. Interpretation of the Timber Lake area would be crucial in satisfying the public's curiosity about breeding birds, such as great blue herons, and educating people about the need for adaptive management planning where the trails would be changed to provide for the least amount of disturbance during nesting. Allowing year round access would greatly increase the potential for comprehensive study and research on the life cycles of local of plant and animal species.

Alternative D would result in a marked increase in environmental education and interpretation opportunities as compared to Alternative A. An extensive, all-weather tour route, with signs and corresponding media (tapes, radio broadcasting) would provide the most comprehensive tour of this Great Basin ecosystem of all the alternatives. This could provide an increased awareness of the natural processes found in this area delivered through a well-developed interpretive venture. A variety of viewing possibilities would exist under this alternative with the development of a riparian bird-watching trail, several towers along the auto-tour route, and an intensive interpretation of the Battleground Point cultural resource area. This extensive education of the public on natural processes and cultural resources would result in a greater understanding of the area and of reasons why the naturalness should not be disturbed and result in satisfying the curiosity of those publics who would have unwittingly caused much damage by their explorations. The upgraded version of the Visitor Contact Refuge would provide increased benefits to the educational aspects of the program with more space for programs, laboratories, an accessible second level observation platform, and research materials. As facilities are enhanced, the possibilities for a quality experience are enhanced, and as more quality experiences are reported to additional publics visitation would increase.

4.5.3 Wildlife Observation and Photography

Alternative A: Stillwater NWR is currently open year-round for wildlife observation and photography. With the current nationwide upward trend in nonconsumptive recreational activity, the density of users is anticipated to rise under baseline conditions but many could be drawn to more developed alternative resources. Under Alternative A, the baseline acreage of wetland-habitat would increase due to the completion of the acquisition program. The primitive opportunities available, limited to fair weather only with no improvements to existing roads, would continue to draw people interested in these conditions. Further increases in observation and photography at Stillwater Marsh during the spring and summer due to increased habitat acreage would be expected, but upland and riparian opportunities would remain at status quo because of limited interpretive and directional signs. Waterbird observation opportunities would continue to be limited during the fall and winter due to all available units for observation being open to hunting. Birdwatchers would not have access to areas in which waterfowl and other birds could become habituated to vehicles and other human activity associated with birdwatching.

Increased camping and boating in the Indian Lakes area of Stillwater WMA because of the population increases in Fallon, Carson City, and Reno could result in a localized decrease in quality for observation and photography opportunities with no additional restrictions placed on these activities. One to three days every few years, controlled burns could affect visitors, and other people in the area. This could take the form of eye and skin irritations, problems with breathing, and could affect visibility.

Alternative B: This alternative would increase observation opportunities in Stillwater Marsh somewhat with the construction of an all-weather tour route and construction of towers. Although fall and winter viewing opportunities would increase under this alternative's water-management scheme, some viewers' opportunities would be limited because the tour route would continue to be inside the hunt area. The quality of the experience for spring and summer viewing would be hampered because additional areas would be closed during the breeding season and because restrictions would require people to remain on the tour route and in designated areas during the nonhunt periods. The restrictions placed on use of the refuge in other than hunting seasons would severely curtail photography opportunities. In consideration of a broad spectrum of users, this alternative offers little for those who wish to see the historic marsh in a fairly primitive state, but does provide opportunity for those users who prefer to frequent formal facilities. Development of an all-weather tour route would increase observation and photography opportunities to include days of inclement weather. With the decrease in upland habitat effected by the boundary exclusion of the Stillwater WMA, opportunities for observation and photography of some sought after species, such as the California quail on Refuge System lands would be limited. Also missing from observation and photography opportunities on Refuge System lands would be the unique diversity of landscapes and fauna found in conjunction with vegetated dune habitat. However, opportunities for wildlife observation and photography in the area now within the Stillwater WMA would continue as they would under Alternative A. One to three days every few years, controlled burns could affect visitors, and other people in the area. This could take the form of eye and skin irritations, problems with breathing, and could affect visibility. Similar to Alternative A, waterbird observation opportunities would continue to be limited during the fall and winter because all available units for observation would be open to hunting.

Alternative C: Year round opportunities for observation and photography would increase in Options 1 and 2 with a balanced emphasis on the six priority recreational uses. The shift in water management, as compared to Alternative A, would offer increased potential for shorebird viewing and photography. An all-weather tour route would increase access during all weather conditions, compared to the "fair weather only" access afforded under Alternative A. Viewing opportunities would be enhanced by a tour loop through the area currently regarded as sanctuary, due to the less complex shoreline configuration and low vegetation and described in the environmental education and interpretation section, would afford opportunity for a shorter trip to view the marsh and its inhabitants. The addition of wetland-habitat along Hunter Road would also add to the viewing potential. Additional restrictions imposed on visitors to remain on trails and in designated areas would not significantly impact opportunities or other Lahontan Valley areas because the tour routes, trails, and interpretation would be well planned and placed accordingly. The development of observation facilities in the Timber Lake area would facilitate the opportunity to view a wide variety of passerines, raptors, and other riparian species. Specific visitation data is not precise enough to address trends, but it is expected that this alternative would provide a more satisfying observation or photographic experience, than Alternative A, due to the availability of interpreted sites throughout the refuge. This interpretation emphasis would presumably result in repeat visitation by observers and photographers. Similar to Alternative A, waterbird observation opportunities would continue to be hampered during the fall and winter because all available units for observation would open to hunting. One to three days every few years, controlled burns could affect visitors, and other people in the area. This could take the form of eye and skin irritations, problems with breathing, and could affect visibility.

Alternative D: Spring photography and observation opportunities would abound under Alternative D. Photography is enhanced by the placement of a blind near the great blue Heron rookery by the Lower Foxtail unit. An increase in trails and interpretative facilities would afford an increased level of satisfaction for the visitor in this alternative when compared to Alternative C, and a vast increase compared to baseline. Shorebird viewing opportunities during fall migration would be higher than those under Alternative C and would be much higher than those under Alternative A, with high mid-summer wetland-habitat acreage declining through the fall shorebird migration period.

4.5.4 Fishing

Under existing conditions and Alternative A, fishing is permitted on Stillwater NWR and Stillwater WMA. With the acquisition of water rights for Stillwater NWR, wetland-habitat has become more favorable to game fish populations. However, at this time, wetland conditions continue to be less than optimum for most game fish (large seasonal and annual fluctuations in wetland-habitat acreage, and high salinity and alkalinity). Nevada Division of Wildlife stocks some species of game fish in the Indian Lakes area. Fish stocked in Lahontan Reservoir and other reservoirs can make their way to Stillwater Marsh. Other fishing opportunities in the affected area include regulating reservoirs, such as Harmon Reservoir, Lahontan Reservoir, and Pyramid Lake. Fishing is not permitted in Carson Lake.

Alternative A: Game fish populations are anticipated to increase as more water rights are acquired, thereby enhancing recreational fishing on the area (WRAP EIS 1996:page 4-111). However, the Nevada State Division of Health issued a health advisory in 1997 for game fish taken from waters in the Lahontan Valley. The health advisory warns that consumers should

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"refrain from eating fish caught from the Carson River in the vicinity of Dayton to the Lahontan Dam and all waters in the Lahontan Valley" due to elevated levels of mercury.

Alternatives B, C, and D: Fishing would not be permitted under these alternatives. This is not anticipated to have any significant impacts on recreational fishing in the Lahontan Valley because little fishing occurs on Stillwater NWR and Fallon NWR at present. The Indian Lakes area would not be included in these boundary-revision alternatives, and fishing would presumably continue as it has in the past.

Mitigation Measures: The action alternatives would have few adverse impacts to fishing on Stillwater NWR because very little fishing occurs at present. To lessen the impacts of totally excluding fishing from Stillwater NWR, fishing could be permitted in designated areas during noncritical times for birds, such as August-October, although molting areas should be avoided. Opportunities for fishing could also potentially be provided during the hunting season without adding substantially to human disturbance effects on birds.

4.5.5 Camping and Boating

Alternative A: Most camping on Stillwater NWR is in conjunction with the waterfowl hunting season, but it does occurs all year long. Camping on Stillwater WMA, primarily the Indian Lakes area, most often occur during the spring and summer months. In Alternative A, camping during October-December would likely increase with hunter densities, causing hardening of sites and minor pollution problems reducing quality of the camping experience for the next users. Camping during the breeding season would likely increase from existing conditions in response to rise in nonconsumptive users. Boating in Stillwater Marsh, under this alternative, would continue with little restrictions. The Indian Lakes area of Stillwater WMA would continue to see an increase in camping and boat use all year long with an increase in the local population and nationwide upward trend in participation in outdoor activities. Quality of these experiences would be directly affected due to pollution of boat launching sites and hardening of camping sites (becoming devoid of vegetation).

Alternative B: This alternative would provide for camping and boating during the hunting season in support of the priority recreational uses. Increased restrictions on boating within the marsh would provide a higher quality experience for some people during the hunting season, but would reduce the quality of experience for others. Boating in support of wildlife observation, during seasons other than hunting, would be limited due to seasonal restrictions as compared to Alternative A. Camping and boating opportunities would presumably continue on the Indian Lakes area.

Alternative C: Because people would be allowed to spend nights on Stillwater NWR in self-contained units and only in designated areas under this alternative, fewer opportunities would be provided as compared to Alternatives A and B. Boating opportunities would be enhanced as compared to Alternatives A and B for the nonhunting public with the development of canoe trails during the spring breeding and summer seasons. Camping and boating opportunities would presumably continue on the Indian Lakes area, and due to added restrictions on camping, camping at the Indian Lakes area could increase as could camping on lands adjacent to Stillwater NWR.

Alternative D: No camping would be permitted under this alternative. Opportunities for boating would be reduced considerably because use would be restricted to motorless or electric-powered crafts during all seasons. Further limitations would occur during the hunting season as a result of the reduced wetland acreage in nonspill years. These restrictions would cause a limit in the recreational experiences provided during the hunting season when compared to the other alternatives. Camping and boating opportunities would presumably continue on the Indian Lakes area, and due to added restrictions on camping, camping at the Indian Lakes area could increase as could camping on lands adjacent to Stillwater NWR.

Mitigation Measures: Measures for mitigating adverse impacts to camping opportunities have already been built into Options 1 and 2 of Alternative C, such as the potential for camp sites on BLM lands, private lands, or other lands adjacent to the refuge.

4.5.6 Other Uses

Other uses are those uses that are not wildlife-dependent recreational uses or do not directly support one or more of the six priority recreational uses. These include but are not necessarily limited to: off road vehicle use, horseback riding, retriever training, and model airplane flying

Alternatives A: Current management allows licensed off road vehicles on existing roads and horseback riding to occur throughout the land now managed by the Service. These uses and others occur on Service managed lands, the majority of the use is concentrated in the Stillwater WMA. Under Alternative A, while these activities would not be promoted, no further restrictions would be placed on them.

Alternative B: Under this alternative, the Indian Lakes area would no longer be within the jurisdiction of the Service and the frequency of other uses in the Stillwater NWR Complex would decline. Within the boundaries of Stillwater NWR and Fallon NWR, under Alternative B, restrictions would be imposed to limit access during all but hunting season, but since very little use occurs other than in the Stillwater WMA, this alternative would have little impact on these uses.

Alternatives C and D: Because most other uses take place in the Indian Lakes area, which would not be included into these alternatives, most uses would see no marked change. Horseback riding would be more restricted, however, on any area other than the Indian Lakes area, as they would be confined to open roads and designated trails only. This would reduce some riders' opportunity, but most would presumably continue to ride in the area and abide by the rules rather than seek an alternate location due to the proximity to the city. With adoption of the purposes outlined in Public Law 101-618 and conforming to guidance provided in the Refuge System Improvement Act, other uses would be increasingly difficult to allow and would have to

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be deemed appropriate and compatible before continuing. It is possible that some uses will not be deemed appropriate and compatible and would have to be prohibited. In that case other areas within the Lahontan Valley would see a slight increase in these uses.

4.6 CULTURAL RESOURCES AND INDIAN TRUST ASSETS

4.6.1 Cultural Resources

Cultural resources, especially archaeological sites, are fragile and nonrenewable. Most of these sites consist of artifacts and such things as seeds and bones, found within a sedimentary soil deposit laying at, or close to, the surface of the ground. Archaeological sites are small, subtle, and thin, when compared to the surrounding landscape and contemporary cultural features, such as roads, ditches, and structures,

The value of cultural resources derives from the interrelationship of the artifacts and ecological remnants such as seeds and bones in soil deposits. Through analysis of these relationships, archaeologists and geologists obtain data that allows an assessment of the age, content, function, and activities represented by the site. Any disturbance to the site will damage these relationships and thus destroy their information potential. Therefore, any activity identified in the alternatives being considered, including land development, grazing, hunting, and changes in public-use have the potential to impact cultural resources. However, as discussed previously, there is a host of Federal legislation that protects cultural resources and requires agencies, such as the Service, to consider, and if necessary, mitigate the impacts of its projects on cultural resources before implementation. The Service will comply with these laws, and thus maintain a basic cultural resource program, regardless of the alternative chosen.

Cultural Resources Defined: Cultural resources are physical remains, sites, objects, records, oral testimony, and traditional life ways that connect us to our nation's past. Cultural resources include archaeological and historical artifacts, sites, landscapes, plants, animals, sacred locations, and traditional cultural properties that play an important role in the traditional, but continuing, life way of a community. Most of the recorded cultural resources at the Stillwater NWR are archaeological sites.

Archaeological evidence shows that human beings have lived in and around Stillwater Marsh for at least 12,000 years. The historic descendants of this legacy are the *Toedokado* or Cattail-eater Northern Paiute of Stillwater Marsh and vicinity. The modern descendants of the *Toedokado* are represented by the Fallon Paiute-Shoshone Tribe whose reservation borders Stillwater NWR. Cultural resources at Stillwater remind us that people were a part of the American wildlife landscape long before European contact.

Stillwater NWR and its surrounding area have hosted pioneering anthropological and archaeological studies throughout the twentieth century. Much of this work is summarized in two documents: *Looking for the Marsh: Past, Present and Future Archaeological Research in* *the Carson Desert* (Raven and Elston 1991) and *In the Shadow of Fox Peak: An Ethnography of the Cattail-Eater Northern Paiute People of Stillwater Marsh* (Fowler 1992). The reader should consult these documents for a comprehensive overview of cultural resources at Stillwater NWR. The Service maintains a complete library of cultural resource information relevant to Stillwater NWR and Management Area including maps, photographs, site record forms, technical and professional reports, literature, compliance documents, and correspondence. Most of the artifacts are curated at the Nevada State Museum in Carson City. Human remains are reintered in an underground vault on a portion of Stillwater NWR closed to the public.

Northern Paiute of Stillwater: Toedokado origin myths place Jobs Peak in the Stillwater Range at the center of creation. From there the first people were dispersed to Stillwater Marsh (and other places) which was filled with water by the tears of the Creator because of warring between his children (Fowler 1992).

The explorers, settlers, and journalists who came into *Toedokado* territory all remarked on the vibrant American Indian population at Stillwater Marsh. The marsh was alive with Indians as much as it was with wildlife and fish. Archaeological research has shown that the marsh has been a human landscape for thousands of years. Archaeological remains of *Toedokado* culture pervade the soil of every island, peninsula, and dune of the marsh. Even the barren playas have yielded evidence of the people.

The *Toedokado* were year-round residents of the marsh. They were not nomads who somehow eked out a living in a harsh environment. They understood the complexities of the ecosystem and were able to extract all the necessary food and raw materials to maintain a rich and thriving culture. For *Toedokado* descendants and members of the Fallon Paiute-Shoshone Tribe, the archaeological sites, sacred places, plants, and animals of Stillwater Marsh are basic elements of individual and group identity. Thus, the management of the Stillwater NWR and its cultural resources is of particular concern to the Fallon Paiute-Shoshone Tribe. As the comprehensive conservation plan compels us to contemplate our interaction with the Stillwater environment today, we must remember that the *Toedokado* and their ancestors have been doing this for millennia.

Archaeological Sites at Stillwater: More than 535 cultural resources, primarily archaeological sites, have been identified and recorded on Stillwater NWR and Stillwater WMA. However, only 7 percent of Stillwater NWR and Stillwater WMA has been searched for cultural resources. If the entire area were systematically inventoried, the total number of cultural resources would tally into the thousands. Few other places in the Great Basin exhibit such a high abundance and diversity of cultural resources in such a small area.

Evidence indicates that most of the Stillwater area archaeological date to the last 4,000 years. The flood of the mid-1980s, which brought national attention to Stillwater Marsh archaeology, revealed many sites dating to a period of 2000 to 1000 years ago (Tuohy et al.1987, Raymond and Parks 1989, 1990). In terms of size and function, the archaeological sites at Stillwater show a lot of diversity. Some sites are represented by a single isolated arrow point, which mark the loss of a hunter's arrow which missed its target. Other sites are packed with the remnants of bustling marshland villages containing dense accumulations of discarded stone tools, food debris, and the remains of house foundations, storage pits, and human burials (Kelly 1987, Raven 1990).

Research between these sites has helped rewrite traditional depictions of Great Basin prehistory. Gone is the belief that Great Basin Indians were constantly on the move, searching for food in a harsh environment. Stillwater has yielded abundant evidence of a relatively stable adaption to wetland resources in semi-sedentary hamlets supported by food storage. The marsh and the surrounding countryside met all the needs of the Toedokado and their ancestors. Archaeological deposits show a reliance on the abundant resources of the area including: hardstem and alkali bulrush, *Sueda*, cattail, freshwater mussel, tui chub, jackrabbits, mice, voles, ducks, coots, geese, swans, pelicans, deer, wolf, mink, and otter (Tuohy, 1987, Raven and Elston 1988).

The archaeological deposits have the potential to reveal the details of environmental change since the last Ice Age, and human adaptation to that change. The Stillwater archaeological sites are reservoirs of data concerning environments, habitats, plants, and animals that have occurred at Stillwater wetlands since the last ice age. Cultural resources research at Stillwater has yielded excellent baseline data on habitats and wildlife that characterized the refuge prior to the European incursion into Nevada.

Archaeologists have developed a model to predict the number, contents, and function of archaeological sites within any defined area at Stillwater depending on the native habitat within that area (Raven and Elston 1989). A field test of the model (Raven 1990) confirms that habitat type is correlated with the abundance, diversity, and content of archaeological material found in the particular habitat. Some of the model predictions confirmed by archaeological fieldwork at Stillwater include the following: Islands and peninsulas in the marsh harbor have the most abundant and diverse archaeological record. They contain the greatest incident of prehistoric habitations, highly diverse artifacts, storage facilities, hearths, abundant food debris, and burials. Habitats characterized by sandy fans and sheets display the least evidence for habitation of all the watered upland habitats at Stillwater. Dry sodic flats, and similar habitats, host evidence of prehistoric hunting stands and game butchering locations. Prehistoric seed gathering and processing locations are most prominent in habitats characterized by sodic sands and gravely loams.

National Register District: In recognition of the cultural resources at Stillwater, the Department of the Interior established the Stillwater Marsh National Register Archaeological District in 1974. This 42,000 acre district includes most of the National Wildlife Refuge and small portions of private and Federal (BLM) land. Although only a small fraction of the district has been systematically inventoried for cultural resources, more than 150 archaeological sites have been recorded in the District. From a management perspective, the National Register District implies that all cultural resources within it are eligible to the National Register of Historic Places until proven otherwise. The Service, the Nevada State Historic Preservation Office, the Advisory Council on Historic Preservation, and the Fallon Paiute-Shoshone Tribe have formal written agreements concerning the management of cultural resources at Stillwater NWR and Stillwater WMA.

Human Burials: One of the salient features of Stillwater archaeology is an abundance of human burials (Brooks et al. 1987, Larsen and Kelly 1995). The flood of the mid-1980s revealed more than 4,000 human bones representing at least 140 people. Overnight, the number of known archaeological human remains in the Great Basin doubled. It is a safe to infer that hundreds more human burials lie just below the surface of greasewood-studded islands and peninsulas of the Stillwater wetlands. The archaeological pattern appears to be that any residential archaeological site may contain one or more human burials. There is a high possibility of encountering human remains almost anywhere in and around the marsh. The exposure of burials does not require a massive erosion event like the flood of the mid-1980s. Localized wind or sheet wash erosion occasionally brings bones or a burial to the surface.

The complexity of managing human burials cannot be overemphasized. They incite more intense emotions and scientific curiosity than most other cultural resources. As physical remains of once living people, linked to descendants represented by members of the Fallon Paiute-Shoshone Tribe, burials require a level of respect and deference that most scientists and land managers do not confer to other resources. Burials are labor intensive to recover, describe, store (temporarily), and rebury. Considerable consultation with the Fallon Paiute-Shoshone Tribe is essential for all human remains. Specific laws, such as the Native American Graves Protection and Repatriation Act (NAGPRA), in addition to the usual suite of historic preservation legislation come to bear upon their discovery. Procedures for identification, recovery, storage, study, and reburial of human remains from Stillwater have been codified in an agreement between the Service and the Fallon Paiute-Shoshone Tribe. Nevertheless, human remains, a constant at Stillwater, always require considerable staff time and careful consideration.

Alternatives A and B: The need to comply with the many Federal laws, regulations, executive orders, and agreements concerning cultural resources means that the Service would maintain a basic level of cultural resources management under these alternatives. In practice, this means that compliance with Section 106 of the National Historic Preservation Act will be the focus of most cultural resource management at the refuge. Cultural resource management under these alternatives can best be described as reactionary. When a project is proposed or when there is a question concerning cultural resources, the Service calls in either the Regional Archaeologist or a contractor to address the issue. The main difference between Alternatives A and B is the addition of a law enforcement officer under Alternative B, would benefit cultural resources protection. No adverse impacts to cultural resources are anticipated to occur with respect to the Alternative B boundary because land status in the area of Stillwater WMA would remain the same as it is now (public lands with a primary withdrawal by the Bureau of Reclamation).

Additional land developments are anticipated under both alternatives and, therefore, the Service would exercise more of the Section 106 process of the National Historic Preservation Act. For example, the construction of water delivery facilities such as canals, dikes, and control structures can impact cultural resources. Therefore, the Service would carry out the National Historic Preservation Act, Section 106 process to ensure that cultural resources are considered in project planning and avoided or treated appropriately before construction is approved.

Water levels under normal operations are not anticipated to reach levels that would inundate archaeological sites (Table 4.23), and therefore would have few detrimental effects on these cultural resources. (The archaeological sites at Stillwater do not occur within the wetlands; they occur on the upland islands and peninsulas that are surrounded by wetlands.) Alternative B calls for intensive management of water levels in wetland units. However, with the possible exception of Pintail Bay, none of the estimated, normal management levels for particular units would exceed the lowest elevation of the archaeological sites in that unit. Alternative B would have more potential than Alternative A for exceeding critical elevations under normal water management operations, but even under Alternative B, this would not occur except under unusual circumstances.

Table 4.23. The minimum elevation of archaeological sites in several wetland units of Stillwater National Wildlife Refuge and equivalent staff gauge readings, and anticipated maximum operation water-surface elevations for each of the units.

	Point at which Sites become Flooded		Anticipated Maximum Operational
Wetland Unit	Staff Gauge (feet)	Water-surface Elevation	Water-surface Elevation
Goose Lake	7.42	3873.5	3872.4
South Nutgrass	7.80	3872.2	3871.8
North Nutgrass	7.48	3871.7	3870.7
West Nutgrass	7.41	3871.6	3870.7
Swan Check	7.40	3871.6	3871.2
Tule Lake	8.37	3872.9	3871.7
Swan Lake	7.87	3872.2	3871.4
Pintail Bay	6.00	3870.2	3870.5

Detrimental effects could still occur during a series of high water years that resulted in sustained high water levels, over which the Service would have little control. Sustained high water levels that inundate archaeological sites cause the most erosion, which is the most serious impact. Waves and ice scour the landforms and sediments holding the cultural deposits and destroy their information potential. High water can wash away wind-deposited topsoil and vegetation that cover archaeological deposits. Stripped of this protective layer, the archaeological sites suffer further erosion from wind and water. They also become easy targets for looters. Increased cover of vegetation along shorelines containing sites would alleviate some of these impacts, but because water levels under normal operations would generally not exceed elevations of archaeological sites, vegetation cover would not increase in these areas.

Fire alone is not considered to have a direct effect on cultural resources. However the excavation of fire lines, staging of vehicles, use of high-powered water hoses, and other fire control techniques can have adverse impacts on cultural resources. Therefore, the Service would comply with Section 106 of the National Historic Preservation Act. If wildfire suppression activities impact cultural resources, the Service will also comply with Section 106 of the Act.

Where livestock grazing occurs in the vicinity of cultural resources, it represents a considerable threat to the integrity of these resources. Cattle trampling damages the sediments that hold cultural resources, especially when cattle gang-up near water sources or moist soil. Therefore, cattle grazing under Alternatives A and B in the area now encompassed by Stillwater WMA would continue to pose a threat to cultural resources. Under Alternative B, cattle grazing would be reduced in Fallon NWR. Little cattle grazing occurs in the historic Stillwater Marsh.

Recreational use under these alternatives can inflict serious damage to cultural resources. Some impacts, such as trampling of archaeological sites by hikers, campers, boat landing and launching, wave action by boat, and the erection of blinds, are unintentional. Other impacts are opportunistic, such as artifact-collecting while hunting or birdwatching. Professional and avocational archaeologists and the Fallon Paiute-Shoshone Tribe are particularly concerned about illegal looting of archaeological sites at Stillwater NWR. This has been a documented problem for decades at the refuge. For people intending to find and take artifacts, recreational activities provide the perfect cover. Facilitating or increasing access to the refuge poses a serious threat to cultural resources. Under the existing network of roads, few restrictions on access (all parts of the refuge being open every day, all day, except in the designated sanctuary), the potential for impacts is high. Restricting people to roads and other designated areas under Alternative B would greatly benefit cultural resources protection because people would not be able to walk around the wetlands for most of the year.

Alternative C: This alternative includes the basic cultural resources protection and compliance requirements of Alternatives A and B. However, under Alternative C, steps would be taken to proactively manage cultural resources as identified in the goals and strategies discussed in Chapter 3. This alternative calls for the employment of a full-time refuge archaeologist who would carry out many of the strategies identified in Chapter 3, which would benefit cultural resources. The refuge would work with the Fallon Paiute-Shoshone Tribe on research, interpretation, and educational activities with cultural resources. Cultural resources would be integrated into environmental education and outreach programs. Furthermore, the needs of and concerns for cultural resources would play a more important role in setting management priorities for the refuge. The presence of an archaeologist onsite would allow cultural resources to be more closely monitored, which would allow more immediate action being taken to prevent damage. Also, cultural resources would receive enhanced protection from looters, as compared to Alternative A, because of the presence of a law enforcement officer. No adverse impacts to cultural resources are anticipated to occur with respect to the Alternative C boundary revision because land status in the areas of Stillwater WMA not incorporated into Stillwater NWR would remain the same as it is now (public lands with a primary withdrawal by the Bureau of Reclamation). Parts of Fallon NWR not incorporated into this alternative are located in the Carson Sink, which does not have any known archaeological sites. Potential transfer of the Indian Lakes area to a non-Federal entity are described in another environmental document (USFWS 1996c).

The construction of water delivery facilities such as canals, dikes, and control structures, can impact cultural resources. However, the Service would carry out the Section 106 process of the National Historic Preservation Act to ensure that cultural resources are considered in project planning and avoided or treated appropriately before construction is approved.

As under Alternative B, this alternative calls for intensive management of water levels in wetland units. However, with the possible exception of Pintail Bay, none of the estimated, normal management levels for particular units would exceed the lowest elevation of the archaeological sites in that unit (Table 4.23), except for a brief period in the early spring. Therefore, it appears that the water levels under this alternative would only inundate known archaeological sites or upland landforms that may contain unrecorded archaeological sites in the early spring for a brief period.

Detrimental effects could still occur during a series of high water years that resulted in sustained high water levels, over which the Service would have little control, although impacts could potentially be lower than anticipated impacts under Alternatives A and B during high-water events. Erosion is the most serious potential problem affecting cultural resources. Sustained high water levels that inundate archaeological sites cause the most erosion. Waves and ice scour the landforms and sediments holding the cultural deposits and destroy their information potential. High water can wash away wind-deposited topsoil and vegetation that cover archaeological deposits. Stripped of this protective layer, the archaeological sites suffer further erosion from wind and water. They also become easy targets for looters. The increased cover of vegetation along shorelines containing sites, as compared to Alternatives A and B, would alleviate some of the above impacts. The springtime pulse of water that would occur in many years in a number of wetland units would allow vegetation to become established above the normal high-water elevation (which is below most archaeological sites). Establishment of vegetation above this elevation would provide additional protection because emergent vegetation slow the erosive power of wave fetch. Upland plants like saltgrass and greasewood trap wind and waterborne sediments that cover and stabilize the sites. Plants also obscure cultural deposits from the eyes of looters. Vegetation plays an important role in protecting archaeological sites.

Effects of cultural resources from fire would be similar to those under Alternatives A and B, and the impacts associated with cattle grazing would be reduced under Alternative C, due to the exclusion of cattle grazing from the riparian corridors and all upland areas. Although cattle grazing could be used in Stillwater Marsh, electric fences or other technique would be used to keep cattle away from shorelines, which would provide protection to cultural resources. Cattle grazing under this alternative would primarily be restricted to disturbed areas, such as farmland.

Further restrictions on recreational use under this alternative would further alleviate impacts to cultural resources, even more so than would occur under Alternative B. Some impacts, such as trampling of archaeological sites by hikers, boat landing and launching, wave action by boats, and the erection of blinds, foot traffic around the marsh during much of the year, and unrestricted camping would lessen, which would greatly benefit cultural resources protection. Other impacts noted in Alternative B would be reduced. Closing West Marsh (Option 1) and restricting access to Willow and Swan Lake during the hunting season to foot-traffic only (Option 2) will reduce impacts in these wetland units. Alternative C would continue to allow people to walk around and into all parts of the most sensitive places for cultural resources (e.g., Nutgrass, Swan Check, and Pintail Bay units) throughout the hunting season.

The environmental education and interpretation program of Alternative C would incorporate cultural resource information that would increase the public's appreciation for: (1) the discipline of archaeology - the methods of turning archaeological facts into information about the past, (2) the role of the Stillwater Marsh in prehistoric human ecology, (3) the importance of cultural resource conservation, and (4) the perspective of Fallon Paiute-Shoshone Tribe on cultural resources and their cultural heritage at Stillwater. The public education and interpretation program would benefit markedly from the preservation, protection, and management of cultural resources at Stillwater NWR.

The construction of visitor facilities, kiosks, trails, roads, etc. can have direct impacts cultural resources by physical alteration and damage of cultural deposits. However, the Service would carry out the Section 106 process of the National Historic Preservation Act to ensure that cultural resources are considered in project planning and avoided or treated appropriately before construction is approved. The indirect effects of visitor facilities include increasing access and numbers of people to the wetlands and its cultural resources.

Alternative D: The effects of implementing this alternative would be similar to Alternative C, except that much higher fluctuations in water levels, under normal operations, could increase the susceptibility of some archaeological sites to damage. Conversely, removing Goose Lake, Tule Lake, and the South Nutgrass unit from the hunt area would provide a much higher level of protection for cultural resources in these units because people would only be able to observe these units from the road.

Mitigation Measures: The habitat, public use, and cultural resource management programs of Alternative C were designed, in part, to minimize adverse impacts to cultural resources, to correct problems stemming from past land-use activities, and to provide increase protection for cultural resources. For example, maximum water-surface elevations for normal operations was influenced by the elevation of archaeological sites, and some of the adverse impacts of public use activities on cultural resources would be mitigated through increased education and interpretation of cultural resources that includes a conservation message. Mitigation would be considered on a case-by-case basis for future construction and other activities.

4.6.2 Indian Trust Assets

4.6.2.1 Fallon Paiute-Shoshone Indian Reservation

Trust assets of the Fallon Paiute-Shoshone Tribe would not be affected by any of the alternatives being considered.

4.6.2.2 Pyramid Lake Paiute Indian Reservation

Alternative A: Based on output of the Below Lahontan Reservoir model, it is estimated that lower Truckee River flows under baseline conditions would be about 489,130 acre-feet per year (Table 4.6) and the water level of Pyramid Lake would be an estimated 3,840 feet above sea level. The cui-ui index under baseline conditions is estimated to be 1,214,500. No actions would be taken under Alternative A that would change Truckee River flows or the water level of Pyramid Lake, or would affect cui-ui. Anaho Island NWR would continue to be managed as it has in the past. The Service would continue to coordinate with the Pyramid Lake Paiute Tribe as outlined in the 1992 Memorandum of Understanding, and this would not change under any alternative. Implementation of Alternative A would have no adverse impacts to trust assets of the Pyramid Lake Paiute Tribe.

Alternative B: Under this alternative, it is estimated, that long-term average Truckee River flows could be slightly lower than Alternative A and the water level of Pyramid Lake in the long term could be slightly lower than Alternative A, but any effects on these parameters would likely not be measurable (Table 4.21). The cui-ui index would also be slightly lower under this alternative. Overall, this alternative could potentially have slight adverse effects on assets of the Pyramid Lake Paiute Tribe.

Alternative C: Under this alternative it is estimated, based on Below Lahontan Reservoir model output, that Truckee River flows could be slightly higher than they would be under Alternative A and the water level in Pyramid Lake would be about the same in the long term (Table 4.6). Therefore, implementation of Alternative C would have no adverse impacts on assets of the Pyramid Lake Paiute Tribe. It is not expected that this alternative would have any negative affects on land assets, water rights, or fish and wildlife resources of the Pyramid Lake Paiute Tribe.

Alternative D: Under this alternative, it is estimated, based on Below Lahontan Reservoir model output, that Truckee River flows would be slightly higher than they would be under Alternative A and the long-term water level of Pyramid Lake would be slighuy higher as well (Table 4.6). This could potentially benefit cui-ui in the long term. Overall, this alternative would have slight beneficial effects on the assets of the Pyramid Lake Tribe. It is not expected that this alternative would have any negative affects on land assets, water rights, or fish and wildlife resources of the Pyramid Lake Paiute Tribe.

4.7 COMMERCIAL HARVEST OF NATURAL RESOURCES

Commercial uses of the Stillwater NWR Complex currently include livestock grazing, muskrat trapping, and harvest of European carp and Sacramento blackfish. Under all action alternatives (Alternatives B, C, and D), these uses would only occur to the extent they are needed to manage wildlife and their habitat. Although there would be a monetary gain by the permittees, the uses would not be managed as commercial uses under Alternatives B, C, and D.

4.7.1 Livestock Grazing

Livestock primarily graze in Stillwater WMA and Fallon NWR, but there is some livestock grazing on Stillwater NWR. Since 1948, livestock grazing on Stillwater WMA, Stillwater NWR, and Fallon NWR has been managed according to direction provided in the Tripartite Agreement that established Stillwater WMA. The agreement stated that livestock grazing would be managed commensurate with the primary purposes of the area, which were to conserve and manage wildlife, provide a public hunting area, and to establish and maintain a sanctuary. According to the Tripartite Agreement, the maximum amount of livestock grazing to be permitted on the area was to be determined annually, "having due regard for the condition of the range, and the wildlife requirements thereon."

During the period of 1988-1997, the number of AUMs that have been grazed on the Stillwater NWR Complex has ranged from about 6,530 to 9,470 (averaging 7,970 AUMs). In the most recent five-year period, AUMs have averaged about 7,200. Less than 400 of these have been on Stillwater NWR, the remainder occurring on Stillwater WMA and Fallon NWR. Most livestock grazing occurs in the Indian Lakes area and a considerable amount also occurs in the Fallon NWR. Most of the upland areas of Stillwater WMA and Fallon NWR are not grazed by livestock, although some areas have been heavily impacted.

The livestock grazing season runs from April through February, with livestock numbers fairly constant throughout the period (about 9 percent of the total AUMs are removed each month) with a slight increase during October-December and small reduction during January and February. March is the only month in which there is no livestock. On Stillwater WMA and Fallon NWR, three permittees generally graze from April through February and the other three, from April through December.

Table 4.24. Estimated cumulative effects of the alternatives on livestock grazing (measured in AUMs) occurring on lands now within Stillwater NWR, Stillwater WMA, and Fallon NWR.

		Cumulative Reductions from Alternative A (AUMs)		
	Alternative A	Alternative B	Alternative C	Alternative D
First year	7,200	470-710	880-1,120	2,890-3,610
Second year	7,200	940-1,420	1,760-2,240	no add'l reductions
Third year (final)	7,200	1,420-2,140	2,640-3,360	no add'l reductions

Alternative A: This alternative assumes a continuation of the existing amount of AUMs being removed (7,200 AUMs/year on average).

Alternative B: Most of the livestock grazing that occurs on the lands now within the Stillwater NWR Complex would not be affected by this alternative, as most of the grazing occurs within the Stillwater WMA outside of Fallon NWR. Therefore, assuming a three-year phasing out of livestock grazing on Fallon NWR and Stillwater NWR, except for use as a habitat management tool, the number of AUMs that could be grazed in the area would decline by 20 to 30 percent, as compared to existing conditions, shown in the final row in Table 4.24 shows the total amount by which AUMs would be reduced under this alternative.

Alternative C: Because most of Stillwater WMA would be within the boundary of Stillwater NWR and because less cattle grazing would occur on Stillwater NWR, reductions in the amount of livestock grazing would be greater than under Alternative B. Reductions from existing conditions would be about 37 to 47 percent by the third year of the phase out, as shown in the final row in Table 4.24. The actions proposed under this alternative would not affect livestock grazing in the Indian Lakes area.

Alternative D: Under this alternative, in which no livestock grazing would be permitted within Stillwater NWR, AUMs grazed by livestock on the lands now within Stillwater NWR Complex would decline by an estimated 40 to 50 percent (Table 4.24). The actions proposed under this alternative would not affect livestock grazing in the Indian Lakes area.

Mitigation Measures: No mitigation measures were identified to mitigate the adverse impacts associated with reducing livestock grazing in the action alternatives, other than to provide some cattle grazing opportunities on the refuge and provide additional opportunities for sheep and goats on an intermittent basis. Significantly reduced livestock grazing opportunities would be an unavoidable adverse impact of these alternatives.

4.7.2 Muskrat Trapping

Alternatives A and B: Under these alternatives, 4,000 to 40,000 muskrats would be trapped each year, assuming a long-term average of 14,000 acres of wetland-habitat.

Alternative C: It is estimated that up to 3,000 muskrats would be trapped each year under this alternative, up to 92 percent lower than Alternative A. Under this alternative, muskrats would primarily only be trapped in the vicinity of water control structures and roads to prevent damage to these facilities. It is possible that considerably more muskrats could be trapped in some years, but this would happen infrequently.

Alternative D: Because no muskrat trapping would be permitted under this alternative, trapping opportunities would be reduced by 100 percent (Muskrat trapping has not occurred in the Indian Lakes area for at least the last ten years).

Mitigation Measures: No mitigation measures were identified to reduce muskrat trapping under the Preferred Alternative, other than providing some cattle grazing and muskrat trapping opportunities on the refuge in some years. Significantly reduced livestock grazing opportunities would be an unavoidable adverse impact of this alternative.

4.7.3 Commercial Fishery

European carp and Sacramento blackfish are periodically harvested from several lakes, including Likes Lake, Papoose Lake, and Big Indian Lake. The emphasis of the commercial fishing program is to control carp and Sacramento blackfish populations. Several hundred to several thousand pounds are removed about every one to three years under a special use permit by issued by the Service.

Alternative A: Commercial harvest of carp and blackfish would continue on a periodic basis.

Alternatives B, C, and D: Commercial harvesting of carp and blackfish would not be directly impacted by the implementation of these alternatives because all of the commercial fishing in the Stillwater NWR Complex occurs in the Indian Lakes area, which would not be included in any of the boundary revision alternatives. Commercial fishing would be regulated by the Bureau of Reclamation and their contractor (TCID) in the short term..

4.8 SOCIOECONOMIC RESOURCES

Historically, farming, ranching, livestock production, and a rural lifestyle have characterized the social and economic environment in the study area. In recent years however, rapid population growth, increased commercial and light industrial development, and expansion of the Naval Air Station-Fallon have changed Fallon, and the surrounding areas of Churchill County. Generally, these changes represent a transition toward a more urban lifestyle.

Several components of the socioeconomic environment, namely the study area population and social structure, are not expected to experience any measurable change as a result of implementing any of the management alternatives considered in this document. Although management alternatives discussed in this document include Anaho Island NWR, the changes being considered would not measurably affect the social and economic resources in the Truckee River Basin. Thus, for the purposes of this document, the social and economic study area will be defined generally as the lower Carson River Basin -- primarily Churchill County, Nevada.

4.8.1 Economics and Employment

According to a report prepared by the University of Nevada, Reno (Department of Applied Economics and Statistics), the major employers in Churchill County are Federal, State, and local governments; the service industry; and wholesale and retail trade. Federal, State, and local governments account for nearly one-third of the jobs in the County and as of June 1996, Naval Air Station-Fallon reported 2,516 active duty military and civilian personnel, including contractors, (oral and written communication, Petty Officer Collins, May 1996). The total number of Federal and State jobs in the County is approximately 3,290.

According to the Nevada Division of Water Planning (Churchill County Socioeconomic Overview, March 1998), the service sector provides about 34 percent of the total jobs in the community. This is followed by wholesale and retail trade with 24 percent of the employment. Agriculture and its associated service sector account for an estimated 8 percent of jobs in the county, while construction provides 7 percent. Mining, manufacturing, transportation and public utilities, finance, insurance and real estate make up the remainder of employment in Churchill County.

Churchill County's total personal income is approximately $176 million (Harris, written communication, 1995). Annual payroll at the Naval Air Station-Fallon, which hosts more than 22,000 military personnel annually, is reported at $77.2 million. In addition to employment dollars, NAS-Fallon on-base purchases and contracts were in excess of $45 million and contributed to the 1998 total economic impact of $125 million for the region (NAS Fallon Environmental Newsletter, Spring 1999). Federal, State, and local government employment accounts for more than one-third of the total personal income in Churchill County. Other personal income sources correspond to the employment figures, with service industry second, wholesale and retail trade third, transportation and public utilities fourth, construction fifth, and manufacturing and agriculture sixth.

Employment and income estimates note that about 7 percent (780) of the jobs in Churchill County are full and part-time agricultural employment. Livestock production accounts for 30 percent of those jobs; dairy and crop production, 35 percent. An additional 600 full and part-time jobs are created indirectly as a consequence of agricultural production (MacDiarmid et al. 1994a; Nevada Division of Water Planning, 3/98).

Net agricultural income (agricultural receipts plus other income from agricultural production less agricultural production expenses) ranged from a single-year loss of $1.5 million in 1983 to a high of $9.75 million in 1990 (MacDiarmid et al. 1994b). Personal income in the agricultural sector (farmer's income and farm labor income in the form of wages and salaries) was also reported at $8.4 million annually.

In a report published by University of Nevada, Reno (Technical Report 93–05), total economic activity in Churchill County is estimated to be in excess of $442 million annually (excluding the State and Federal sectors). Of this total, the service sector contributes about 18 percent, followed by mining (14 percent), construction (13 percent), agriculture (12 percent), wholesale and retail trade (11 percent), and transportation and utilities (11 percent). Other sectors comprise the balance (21 percent).

Cattle ranching and dairy production are the primary livestock-related agricultural activities in the study area. Total cash receipts in 1996 for Churchill County's Livestock and Livestock Products was $30 million; dairy production, $42 million. In terms of crop production, alfalfa represents the dominant crop, although some wheat and barley are grown in the area. In 1996, cash receipts from crop production were $7.3 million (Nevada Agricultural Statistics: 1997-98, October 1998).

4.8.2 Population

Communities in the lower Carson River Basin, like much of Nevada, are experiencing population increases at a steady annual rate. Churchill County's population, for example, grew by more than 3 percent annually between 1990 and 1996 (U.S. Bureau of the Census and Nevada State Demographer) and almost 6 percent between 1996 and July 1, 1997 (Nevada Division of Water Planning, March 1998). In 1997, Churchill County's population base was approximately 23,860 residents, which included residents of the Fallon Paiute-Shoshone Indian Reservation. Fallon is the largest city in the county -- in which approximately 35 percent of the County's population reside. Growth is projected to continue at a rate of about 2 percent over the next five years.

Another indicator of population growth is the number of building permits issued annually. A 1996 Lahontan Valley News article stated that the number of permits issued was up 32 percent during the period January 1-October 31 when compared to the same period in 1995. With population increases, comes an increased in demand for social services, such as schools, police and fire protection, water and sewer service, and other community infrastructure requirements.

The study area's population and social structure are not expected to experience any measurable change as a result of implementing any of the alternatives considered in this Draft EIS.

4.8.3 Land Use

There are 13 different land use zones in Churchill County, patterns which can best be described as discontinuous. It is common to find residential use adjacent to industrial or commercial use, all of which is surrounded by agricultural lands. This diverse land use mix is less prevalent in the City of Fallon.

Growth in Churchill County develops as new commercial and industrial land use radiates out from the City of Fallon's core along major transportation corridors. New residential areas develop along these transportation routes as well. As a result, this expansion of industrial, commercial and residential land-use pattern displaces the prior land use, typically agricultural (irrigated farm lands or grazing lands).

In terms of tax assessment classification purposes, the Churchill County Assessor's Office differentiates between lands for agricultural and nonagricultural uses. Those lands classified as agricultural are further separated into five categories, by use and production, including intensive use and farmsteads, cultivated, wild hay, pasture, and grazing -- grazing is the largest of the categories. Nonagricultural parcels are classified as vacant (parcels with minor or no improvements), residential, commercial, industrial, and mining.

More than 95 percent of Churchill County's 3.1 million acres is classified as fourth-class grazing lands or rangelands. The balance, or approximately 355,000 acres, remain classified as agricultural. As of mid-1995, cultivated and pasture lands accounted for 54,147 acres in the area, a decline of 16.3 percent from 64,698 acres as reported in 1987. Most of the irrigated agriculture in Churchill County is in the Newlands Irrigation Project, of which about 91 percent occurs on lands with recorded water rights.

In other land classification matters, residential units in Churchill County increased 29 percent between 1989 and 1995; 23 percent increase for the same time period in the city of Fallon. Commercial and industrial parcels grew by 19 percent over the eight years prior to 1995. Mobile home permits increased 24 percent during the same period.

Alternatives A and B: There would be few changes to land use within the boundaries of Stillwater NWR and Stillwater WMA, beyond those of the water-rights acquisition program.

Alternatives C and D: Under these alternatives, additional private lands along the Carson River could potentially be acquired, which could potentially affect Churchill County's tax base.

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4.8.4 Commercial Uses on Stillwater NWR Complex

Livestock grazing is permitted on portions of the Stillwater NWR, Stillwater WMA, and Fallon NWR. Over a five-year period, the number of AUM's associated with grazing permits issued for the Refuge complex averaged 7,200. The primary grazing season generally extends across a six-month period (April-September); however, livestock grazing occurs throughout the year. Available forage supports on average, approximately 640 cow/calf units across the grazing season, translating into a market value of $62,000 (based on a cow to calf ratio of 1:1, at $65/cwt market price, and a 300-pound market weight) and contributing about 0.2 percent of the total 1996 livestock receipts for Churchill County. It is likely that this value is overstated, because the assumptions consider that the livestock grazing is permitted year round, a constant AUM rate, and that no alternative grazing opportunities exist. Permits are issued annually for a fee, which is generally based on the numbers of AUMs and the current market rate for public land grazing.

Cultivatable lands managed by the Service have been leased to area farmers during the last two seasons. Typically, alfalfa is grown and benefits not only the lessee (in terms of revenues from alfalfa sales), but also waterfowl that use the crops as a food source. For the purposes of this Draft EIS, it is assumed that no lands are leased to farmers, as no Service water rights are available to irrigate refuge farmland over the long term and mechanisms for getting water to refuge farmland have not been worked out.

Other consumptive use activities associated with the Stillwater NWR Complex include muskrat trapping and commercial fishing. The Service issues several permits annually, to the highest bidder. There are no limits established on the numbers of pelts harvested and the market price fluctuates considerably (for example, the average price paid for a muskrat pelt currently is between $0.75 to $1.00; last year, prices ranged from $2.00 to $2.50). The Service does not receive a fee for trapping, but collects revenues from limited permits that are issued to the highest bidders. According to Service records, 2,400 muskrat pelts were harvested, with a market value of approximately $3,700 (assuming an average price per pelt of $1.55). Trapping activity fluctuates with market price and muskrat populations. None of the alternatives would affect commercial fishing operations.

Economic effects from the management alternatives identified in this document are expected to involve primarily the commercial and recreational activities that occur on Service-managed lands. In some cases, economic benefits are anticipated from visitation enhancing activities; in other cases, some economic losses may occur. The intent of this section is not only to identify those effects, but also to quantify the attendant changes as appropriate.

Alternative A: Under this alternative, livestock grazing is expected to continue as it has in the recent past. Although some leasing of cultivatable lands currently exists, this practice is not expected to continue beyond the immediate time frame (two to three years). Continuation of this program is conditional on the availability and elected use of nonwetlands water rights. Due to the anticipated short tenure of this program, this section will not delve on the economic impacts associated with vegetative production for commercial purposes. Muskrat trapping would also continue as in the recent past, except that considerably more pelts would be harvested under baseline conditions, as compared to existing conditions due to increased water supplies.

Table 4.25. Potential changes to revenues from livestock grazing on the Stillwater NWR Complex.

	Alternative A (No Action)	Estimated Changes from Baseline Conditions		
		Alternative B (Modified No Action)	Alternative C	Alternative D
Contribution to Livestock Sector Industry Output	$62,000	reduced by $12,000 to $18,000 (20% to 30%)	reduced by $23,000 to $29,000 (37% to 47%)	reduced by $25,000 to $31,000 (40% to 50%)

Note: Percentages in parentheses represent the percentage change from the baseline condition, i.e., the No Action Alternative.

Alternatives B, C, and D: Other alternatives would result in a reduction in livestock grazing, subject to identified refuge management purposes and priorities. The direct impacts of the alternatives on livestock grazing are based on the baseline levels of forage, as identified above. Under liberal assumptions (i.e., that livestock is permitted year-round at a constant forage rate with no alternative forage opportunities), the forage identified with the areas of the Refuge where grazing is authorized and occurs, contributes about $62,000 annually toward the livestock sector economic output in Churchill County. Reductions in livestock grazing levels (in terms of permitted AUM's) on Refuge-managed lands range from 20 to 50 percent, depending on the management alternative. Although these impact estimates suggest reductions in cash receipts from livestock grazing – up to 50 percent in Alternative D – from Alternative A, in fact, reductions in grazing levels will be phased in over a three year time frame, except for Alternative D. By phased reductions in grazing levels over time, the economic burden on the affected permittee – in terms of finding alternative forage sources, is tempered. Nonetheless, under those management alternatives in which reductions in grazing levels are called for, those permittees affected must necessarily locate alternative forage sources or reduce herd sizes.

Under the four management activities advanced in this planning document, only Alternatives C and D introduce more restrictive limitations on muskrat trapping. Table 4.26 illustrates the economic impacts of this activity across management activities. The estimated revenues shown in the table are likely overstated, mostly because of the numbers of pelts expected to be harvested under each of the alternatives; it is unlikely that the upper extent of the estimated revenues would be realized. Market prices for pelts fluctuate greatly and even while pelts were selling for $2.00 to$2.50, a total of 2,400 pelts were harvested.

Table 4.26. Potential changes to revenues from muskrat trapping on Stillwater NWR.

	Alternative A (No Action)	Estimated Changes from Baseline Conditions		
		Alternative B	Alternative C	Alternative D
Muskrat Trapping Revenues	$6,200 to $62,000	$0	reduced by $6,200 to $57,350	reduced by $6,200 to $62,000

Note: Revenue estimates assume a muskrat pelt market value of $1.55 each

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Clearly, when compared to current conditions, Alternatives C and D impose restrictions on this activity; Alternative D more so as it prohibits trapping altogether. Estimated revenues identified for each alternative assume a long-term average of 14,000 acres of wetland-habitat.

4.8.5 Wetlands and Related Outdoor Recreation Economics

In addition to the more visible activities associated with wetlands that contribute to a local and regional economy, such as birdwatching, hunting, and general recreation, there are other social benefits that may accrue. Between these benefits, as they relate to the Lahontan Valley wetlands complex, are (1) the role of the wetlands in the Pacific Flyway in terms of its contribution to the quality of waterfowl hunting throughout the flyway and (2) the impact of the wetlands on nongame species of birds. Further, there is an existence value associated with the wetlands complex, as a remnant of ancient Lake Lahontan and the knowledge that the wetlands exist.

Wetland-habitat acreage at Stillwater NWR has varied considerably, ranging from 30,000 acres in 1983-84 to 700 acres in 1992. The availability of water to the Service is one variable in the size of the wetlands, in terms of actual wetland-habitat acreage. As additional water rights are acquired for Stillwater NWR and the Lahontan Valley wetlands complex -- up to the 25,000-acre annual average, the variability in wetlands acreage is expected to decline. Because water affects the amount of wetland-habitat acreage, both water and wetland-habitat acreage contributes directly to annual visitation rates. The number of hunters, anglers, and general recreationists fluctuate in response to wetland-habitat acreage -- to a point (such as during flood years, when a decline in the number of places to hunt and engage in other recreational activities occurs).

According to visitation records kept at the Stillwater NWR office for the five year period from 1993 to 1998, of the total recorded visits to Stillwater NWR, over half were associated with non-consumptive activities such as nature observation and environmental education. The balance of visits were recreational, typically consisting of hunting, fishing, muskrat trapping, and general recreation, of which hunting represented 5 to 20 percent. The results from an on-site survey conducted by the University of Nevada-Reno in 1998 comport with the Refuge's visitation information—hunting activities represented slightly more than 20 percent of the "general" recreation visitation rate (Englin et al. 1998).

This survey also examined visitation and recreation expenditure patterns exhibited by visitors to the Lahontan Valley wetlands complex. On a per-capita expenditure basis, hunters generally spent almost $38 per day, people engaging in general recreation activities spent $21. Using this per-capita information for a basis, expenditures associated with both general recreation uses and hunting activities at Stillwater NWR alone exceeded $615,000 during the 1997-98 season and would include expenditures generally associated with lodging, food, gasoline, firearms, and the like.

Alternatives B, C, and D represent management activities that would change the present management of the Refuge, in terms of recreation and other wetlands-based outdoor activities. Some of the changes identified in the various management alternatives are quantifiable; others are not. Of the former category, hunting and fishing are consumptive activities and can be examined with respect to expenditures by the individuals who participate. Other recreational activities that are nonconsumptive (in terms of the resource), yet economically meaningful, include birdwatching, picnicking, and other nonmarket, and thus less quantifiable, benefits associated with the wetlands complex (value of the wetlands to nongame bird species and the Pacific Flyway and the existence value identified with a wetlands complex).

Table 4.27. Potential effects on hunter and other expenditures, and on nonmarket benefits.

	Alternative A (No Action)	Alternative B (Modified No Action)	Alternative C	Alternative D
Hunter Expenditures	72% of area open; ≈ $250,000	67% of area open; ≈ $250,000	50% of area open; ≈ $250,000	40% of area open; expenditures reduced by $110,000
Other Recreation Expenditures	$490,000	+ $5,000 (+1%)	+$120,000 (+25%)	+ $147,000 (+30%)
Nonmarket Benefits & Attributes	+	+	++	+++

Hunting opportunities, and to some extent general visitation, on Refuge-managed lands are dependent on several factors – accessibility (controlled either by management or water levels) and the number of game (and nongame) birds and other wildlife in the area. Insofar as the quality of hunting opportunities is concerned, then possibly, that value is reduced across Alternatives A, B, and C. However, numbers of hunters, and therefore related expenditures, may not be necessarily affected – according to Refuge data, hunter density is relatively low on weekends under current access management. Under such an assumption, no reductions in hunter numbers and thus, expenditures, is expected for Alternatives A, B, and C. The amount of area identified as open to hunting under Alternative C (Table 4.27) was based on Option 1 of that alternative, and therefore would be a conservative estimate for Option 2 which would provide for a greater proportion of habitat open to hunting.

Activities involving birdwatching and environmental education at the Refuge are likely to experience increased levels of visitation, with the anticipated construction of a visitor's center, interpretative trails, boardwalks, observation towers, road signs, and the like. The highest levels of visitation, all other things held equal, are associated with Alternative D, when compared against current Refuge visitation. Further, Alternative D also represents an enhancement of nonmarket benefit attributes over the other alternatives; these benefits are, at present, not readily quantifiable.

4.8.6 Potential Changes to the Local and Regional Economy

Although slight, direct changes in the output of any local economic sectors results in a "ripple" effect throughout the other sectors. By examining the anticipated changes in these sectors, the regional (direct, indirect, and induced) economic effects can be better identified and described.

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Table 4.28. Direct, indirect, and induced changes associated with each alternative.

		Change from Alternative A		
Activity	Alternative A	Alternative B	Alternative C	Alternative D
Livestock Grazing	$130,000	–20% to –30%	–37% to – 47%	–40% to –50%
Muskrat Trapping	$12,000 to $120,000	no change	–90%	–100%
Hunting	$515,000	no change	no change	–55%
General Recreation	$1,030,000	+1%	+25%	+30%
Contribution to Local Economic Activity (Total of Above)	$1,675,000	– 0.9% to –1.7%	+5.2% to +11.8%	–2.3% to –9.5%
Change in Hydropower Resources (Total for New Lahontan Reservoir plant)	$1,120,000	–2.8%	–14%	–3.7%

Notes: Alternative A, as representing the No Action Alternative, is assumed to depict baseline conditions, to which the estimated changes associated with the other alternatives are compared. Numbers have been rounded.

Definitions:
Direct Impacts: Activities or changes in production levels of the impacted industry
Indirect Impacts: Changes occurring in the local business sector as a result of providing inputs to the impacted industry
Induced Impacts: Economic activity caused by household consumption in a local economy from the direct and indirect effects

4.8.7 Employment and Population

Additional Refuge staff would be required to carry out several management alternatives. Since these additional employees will likely live in Fallon, or the immediate vicinity, they and their families will add to the population and employment base of Churchill County. Management alternatives will add from three (Alternative B) to five (Alternatives C and D) additional employees, resulting in the addition of approximately eight to 13 people to the Churchill County population base. This change to the population base is not expected to result in any negative impacts on the community social structure or Fallon's infrastructure. Other than employment gains from several of the alternatives considered, there are no significant employment impacts anticipated from the imposition of any management alternative (in terms of losses from grazing opportunities, hunting, etc.).

In summary, the alternatives considered in this Draft EIS would, in all likelihood, result in small, overall changes to the local economy, either positive or negative, from the conditions prevalent today.

4.8.8 Geothermal Leasing

The known geothermal resource area in the vicinity of Stillwater, Nevada (Stillwater KGRA) comprises 33 sections of land, about 21,120 acres. Eleven of these sections are within the

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existing approved boundary of Stillwater NWR, and 3 are within the Stillwater WMA, just north and to the east of the Fallon Indian Reservation. Within an approved refuge boundary, the Geothermal Steam Act requires that any geothermal leases that existed on Federal land prior to the establishment of an approved refuge boundary or that existed on nonFederal lands prior to their acquisition will remain valid through the duration of the lease. However, such leases would not be renewed on any Federal lands within the refuge. Geothermal leases on Federal lands within Stillwater NWR would be managed subject to the Geothermal Steam Act. An approved refuge boundary does not have any bearing on the potential to lease geothermal resources on nonFederal inholdings within the boundary or to extend such leases.

Boundary-revision Alternative B would not have any effect on geothermal leasing. To the extent that boundary-revision Alternative C is revised to include a known geothermal area and other adjacent areas in which geothermal resource could be leased, future opportunities for leasing geothermal resources could be diminished in the Stillwater KGRA, except where existing valid rights exist (whereby the terms of the lease would be honored). One additional section (640 acres) of the Stillwater KGRA would be included in Stillwater NWR, as compared to the existing approved boundary, although there are additional lands on which leases have been submitted to the Bureau of Land Management for consideration. There are no existing geothermal leases within the boundary-revision proposal under Alternative. Potential adverse effects under Alternative C could include lost opportunities for increased economic activity and revenues in Churchill County. This is not expected to have any significant adverse impacts as compared to existing or baseline conditions.

Alternative D would have similar potential effects, except that an additional four sections (2,560 acres) of the Stillwater KGRA would be included in Stillwater NWR, as compared to the existing approved boundary. Leases have also been proposed outside of the Stillwater KGRA within the Alternative D boundary-revision.

Mitigation Measures:

One way to avoid any potential loss in opportunities to increase revenues and economic activity in Churchill County would be to adjust part of the southern boundary of Alternative C and D so that the known geothermal resource area and other areas encompassing proposed lease sites are not included within the new additions to the Stillwater NWR.

4.8.9 Other Potential Effects

Under an agreement between the U.S. Department of Agriculture's Wildlife Services Division (formerly known as Animal Damage Control) and several landowners within the existing approved boundary of the Stillwater NWR, Wildlife Services conducts measures to prevent or reduce impacts on private lands from several species of wildlife species on private lands, especially during the calving season (Wildlife Services, USDA, letter dated February 26, 1999). The agreement covers coyotes, striped skunks, beavers, blackbirds, and common ravens, and several control techniques including aerial and ground shooting, trapping (leghold, cage, conibear, and snares), denning, and DRC 1339. Wildlife Services has proposed that they be

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permitted to continue control operations on the parcels that are acquired by the Service within the existing approved boundary of Stillwater NWR.

No plans have been made under baseline conditions (Alternative A) to continue this program on refuge lands. Therefore, slight increases in predation rates on adjoining properties could occur. Continuing the agreements on lands acquired by the Service within the approved refuge boundary could be done under Alternative B, with modification. Such a program under Alternative B could be melded with the predator control program designed to enhance waterbird production. This could help to alleviate predation of young livestock on calving grounds and to reduce damage to crops. Effects under Alternatives C and D would be similar to those under Alternative A.

4.9 NAVAL AIR STATION-FALLON OPERATIONS

The potential expansion of Stillwater NWR boundary northward toward the Bravo Twenty Bombing Range has raised concerns by the Naval Air Station-Fallon. Under existing and baseline conditions, the bombing range is seven miles north of Stillwater NWR and about seven miles northeast of Fallon NWR. A 3,000-foot ceiling (aircraft are not permitted to fly lower than 3,000 feet) exists over Stillwater NWR, Fallon NWR, and Stillwater WMA.

Alternatives A and B: The existing agreement would be carried forwarded, except that the lands now within Stillwater WMA would be removed under Alternative B.

Alternatives C and D: Under these alternatives, the distance from the Bravo Twenty Bombing Range would diminish to one mile, but the distance to the northern edge of the west side of the refuge (where Fallon NWR is now located) would increase to about 9-1/2 miles. The Service would continue coordinate with the Navy and would finalize an amendment to the existing memorandum of understanding to address the Navy's concerns. In particular, the 3,000 to foot ceiling would not apply to the extended portion of Stillwater NWR. Therefore, the boundary expansion toward the Bravo Twenty Bombing Range would not affect Naval Air Station-Fallon operations.

4.10 EFFECTS ON REFUGE MANAGEMENT

4.10.1 Habitat Management Techniques

This section, is included because restrictions on the use of management tools are of concern to managers. A variety of habitat management techniques (also known as management tools) can be used to help control invasive species, promote wildlife and habitat, simulate ecological processes, and provide different mixes of habitat types. These tools include biological controls (livestock grazing, muskrat herbivory, and insects), fire, management of wetland water levels, mechanical treatments (mowing, discing, root plowing), chemical treatments, explosives, and wildlife population control (ravens, muskrats). For any given set of management tools available at a particular area, each tool is used at differing levels based on need, ability, aesthetics, and regulation. Many of these tools have been used in the past based on identified resource needs, but some, like prescribed burning and saltcedar control, have only been used to a limited degree during the last ten years. Also, livestock grazing and muskrat trapping are not being used as management tools in the existing program (they are provided as commercial uses). Management tools used will vary under each alternative based on the focus of each alternative's management direction.

Alternative A: This alternative would allow the manager to use a wide variety of management tools with few restrictions imposed. However, the actual use of management tools at present is less than what can potentially be implemented. Under this alternative, water level management would be the primary means to manage marsh habitats. However, all of the above management tools could be used depending on identified resource needs and completion of appropriate compliance documents. A predator control plan could potentially be developed and implemented to promote waterfowl production. while water management and limited use of Rotenone could provide a control technique for European carp. Livestock grazing would continue to be a commercial use near marsh habitats, but would not be implemented with specific vegetation management goals in mind. Release of beetles, which consume the leaves of saltcedar, would be considered part of the biological control program if clearance is received to use this method; however, chemical and mechanical treatment on a limited basis would remain viable methods to control saltcedar and other invasive species. Explosives would continue to be a means of keeping channels open and provide other openings within deep emergent habitat.

Alternative B: Management tool use would be higher than baseline under this alternative with few restrictions imposed. This alternative would be similar to baseline with primary management emphasis on creating quality fall and winter foraging habitats for waterfowl and retaining summer deep emergent vegetation habitat for the production of redheads. Water management and prescribed burning would be the primary management tool use with a focus on summer drawdown to promote moist-soil habitat while providing enough water to maintain some deep emergent and submergent vegetation through summer months. To ensure that deep emergent habitat is at an optimal 50/50 mix with submergent vegetation, prescribed burning, controlled livestock grazing, mechanical treatments, and muskrat trapping would all remain in the toolbox. Herbicide and explosives would not be used to obtain this mix. Additional management tools that could be used include controlling invasive vegetation through mechanical and chemical methods. An integrated pest management plan would be implemented to provide guidance on optimum invasive species control treatment combinations.

Alternative C: Management tool use would be higher than baseline, although more restrictions would be placed on the use of the more intensive management tools. None of the tools currently being used on Stillwater NWR would be excluded from use and a few may be added, such as sheep and goat herbivory. While Alternatives A and B emphasize management for populations of species of special interest (key species), this alternative focuses on the entire native marsh community with a key strategy of simulating the natural hydrology and associated processes. Therefore, management activities would be conducted in such a way as to promote the functioning and appearance of a natural system. Similar to the previous alternatives, water level management would be the primary tool used; however many of the previously mentioned management techniques could also be used, such as prescribed burning, livestock grazing, and mechanical treatments. Under this alternative, most applications of management tools would be employed to mimic natural ecological processes or to otherwise approximate ecological conditions. Considerable biological justification would be required before techniques, such as controlled livestock grazing, chemical treatments, large scale mechanical treatments, or predator control would be implemented. Reasons for use of these tools are instances where it can be shown that habitats or wildlife populations deviate considerably from estimated historic conditions. Less reliance on chemical treatments and cattle grazing would be practiced under this alternative as compared to Alternative B, but more so than under Alternative A. Integrated pest management (including weed management) methods and techniques would be available for use subject to further examination of specific target and nontarget effects as per Service review and approval.

Alternative D: Use of management tools would be much lower than baseline under this alternative, and intensive management tools, such as livestock grazing and chemicals would not be permitted. All management tools would be implemented to approximate natural ecological processes, emphasizing the least intensive tool available to fulfill specific, identified management needs. Similar to Alternative C, the management focus would be on simulation of natural processes to help restore a natural biodiversity of wildlife and habitats, although this alternative emphasizes this aspect more so than Alternative C. More reliance on water level management over any other management tool would be achieved. No management tools would be used unless management plans are specifically designed to simulate natural ecological processes at natural levels of occurrence.

4.10.2 Effects on the Ability of the Service to Meet Legal Mandates

Alternative A: Continued management under Alternative A would limit the Service's ability to achieve the purposes of Stillwater NWR and Fallon NWR, as well as directives under the Refuge System Administration Act, as amended. The existing management program for Stillwater WMA and much of the area within Stillwater NWR and Fallon NWR was designed under the tenants of the 1948 Tripartite Agreement and has not addressed the Refuge System Administration Act.

From the standpoint of achieving refuge purposes, the seasonal pattern of delivery of Alternative A would be more desirable than Alternative B, but less desirable than Alternatives C and D. With respect to restoring natural biological diversity, opportunities for protecting and restoring the lower Carson River, an entire dune ecosystem, and a considerable amount of upland desert shrub habitat would be impaired, but not foregone as it would be in Alternative B. The hydrology of Stillwater Marsh would be markedly different from the natural seasonal flow pattern, and attempts to convey more water through the marsh during early spring would not be attempted. However, the seasonal pattern of wetland-habitat acreages would be similar to some years under natural conditions system when the Carson River flowed directly into Stillwater Marsh, although the volume of inflow would be considerably different.

Given the change in purposes and shift in priorities, this alternative would forego an pportunity to permanently protect additional habitat and would continue to place relatively little emphasis on restoring these habitats, and would continue to place relatively little emphasis on providing

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sanctuary for migratory birds during the hunting season. For similar reasons, fulfillment of international treaties would be hindered under this alternative. Next to Alternative B, this alternative would be least desirable as a strategy for management as a component of the Western Hemispheric Shorebird Reserve Network.

Because the public-use program would continue to be dominated by the hunting program, this alternative, along with Alternative D (which would severely restrict the hunting program), would be least desirable from the standpoint of the public-use purpose and related provisions of the Refuge System Administration Act, as amended.

It is anticipated that the Service could achieve the 14,000-acre target under the existing water-rights acquisition program.

Alternative B: Of the alternatives considered, Alternative B would be the least desirable from the standpoint of achieving most refuge purposes. With respect to restoring natural biological diversity, opportunities for protecting and restoring the lower Carson River, an entire dune ecosystem, and a considerable amount of upland desert shrub habitat would be foregone. Furthermore, the hydrology of Stillwater Marsh would be markedly different from the natural seasonal flow pattern, and attempts to convey more water through the marsh during early spring would not be attempted. The emphasis would be to provide high-quality fall and winter habitat for waterfowl and waterfowl hunting.

Some improvements would be made toward the conservation and management of fish and wildlife in general, but this alternative would forego an opportunity to protect additional habitat (riparian, dunes, greasewood shrublands), would continue to place relatively little emphasis on providing sanctuary for migratory birds during the hunting season. For similar reasons, fulfillment of international treaties would be hindered under this alternative. Of the action alternatives, this alternative would be the least desirable for shorebirds, and therefore would be least desirable as a strategy for management as a component of the Western Hemispheric Shorebird Reserve Network. This is primarily because water levels would be rising in wetland units during fall migration.

Although opportunities for wildlife-dependent recreation would be enhanced under this alternative, as compared to Alternative A, it would not be the most desirable alternative from the standpoint of the public-use purposes of the refuge. Opportunities for hunting would be enhanced, but opportunities for enhancing wildlife observation and environmental education along the lower Carson River would be foregone. Furthermore, large areas of the refuge would be closed to visitors during the breeding season, which is the most popular time for wildlife observers and school groups to visit the refuge. Therefore, Alternative B would not be consistent with the provisions of the Refuge System Administration Act, as amended, with respect to facilitating all public-uses

Strictly from the standpoint of achieving the 14,000-acre wetland-habitat target for Stillwater NWR, Alternative B would be the most desirable because the targeted acreage could be achieved with a lesser amount of water than under any other alternative considered. This would make it

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easier to achieve the 25,000-acre primary wetland-habitat target for Lahontan Valley, as required in Public Law 101-618.

Alternative C: Of the alternatives being considered, Alternative C would be the best for achieving refuge purposes. If implemented, it would result in the most progress toward mimicking ecological and biological processes and approximating natural biological diversity. The natural seasonal flow pattern would be mimicked, as adjusted in recognition of markedly less water than natural conditions and to minimize nest flooding and to ensure that wetland-habitat is provided in the fall and winter for waterfowl and waterfowl hunting. The addition of the lower Carson River, the 25-mile long dune system, and additional upland desert shrub habitats would contribute greatly toward the achievement of refuge purposes (a criterion of the boundary-revision provision of Public Law 101-618). For similar reasons, including the restoration of river-riparian systems, efforts to restore the biological integrity and environmental health of the Stillwater NWR ecosystem, as required by the Refuge System Administration Act, would be best under Alternative C. Under Alternative C, implementation of the core reserve concept would be better under Option 1 as compared to 2 (neither alternative follows this principle to any large degree, however).

Alternative C would be best for achieving the purpose providing for the conservation and management of fish and wildlife, although each alternative differs in philosophies and assumptions. This alternative is somewhat better than Alternative B because it would protect and restore additional wildlife habitat, especially river-riparian habitat and dune habitat, and Alternative C would provide additional secure habitat for waterfowl and other waterbirds. Alternative C would contribute most toward fulfilling international treaty obligations for some of the same reasons listed above: restoration of natural habitat conditions (including wetlands), additional habitats being protected and restored, and providing suitable sanctuary for migratory birds. Due to differences in the management of human disturbance, Option 1 would be the best from the standpoint of fulfilling international treaty obligations, as this option would be more beneficial to migratory birds during the hunting season. With respect to the Western Hemispheric Shorebird Reserve Network, Alternative C would benefit fall migrating shorebirds to a greater degree than Alternatives A and B because of relatively high wetland-habitat acreage in late July followed by receding water levels through August and September.

Option 1 of Alternative C, would be the best alternative, of those considered, in terms of balancing public uses on Stillwater NWR. Compared to Alternative B, it would provide additional opportunities for wildlife observation and photography, and environmental education and interpretation. Even so, it would be slightly more restrictive to waterfowl hunters (more regulations, less available habitat for hunting). Option 2 would improve conditions for wildlife observation and environmental education to a lesser degree than would Option 1 (e.g., the wetland tour route would be farther from the refuge entrance, no separation of uses during the hunting season), but hunters would not be impacted as much as they would be under Option 1. For similar reasons, Option 1 would best meet requirements of the Refuge System Administration Act, as amended. However, given the current interest of the people and groups that provided scoping comments, separation of uses is not viewed as a desirable condition at this time.

Alternative C would be the best alternative of those considered for achieving purposes of Fallon NWR (even though these would likely be replaced by Stillwater NWR purposes under this alternative). Retaining the lower Carson River would allow for the acquisition of additional land and water along the river, which would result in more water reaching the wetlands at the delta of the Carson River (Battleground Point area).

According to wetland water-delivery modeling, the amount of water to be acquired through the Service's water-rights acquisition program would be sufficient to sustain a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR, meaning that Alternative C would have no adverse effects on the acquisition program.

Alternative D: The Service's ability to achieve Stillwater NWR purposes would be hindered under this alternative for several reasons, as compared to Alternative C. There would not be an opportunity to provide higher amounts of wetland-habitat acreage during the late-summer, fall, and winter, except in spill years. Under natural conditions, wetland-habitat was available in Stillwater Marsh year round in most years when the Carson River flowed into Stillwater Marsh or Carson Lake. Although the proportional amount of inflow would have been similar to that mimicked by Alternative D, the volumes were significantly higher, allowing more habitat to remain through the year. Another reason is that the control of invasive vegetation, a significant threat to native plant community composition and structure, would be hindered under this alternative because of restrictions on the use of herbicides and biological controls. Higher variability in water levels would exacerbate the problem by increasing the distribution of saltcedar. For similar reasons, efforts to restore the biological integrity and environmental health of the Stillwater NWR ecosystem, as required by the Refuge System Administration Act, as amended, would be impaired. Conversely, implementation of the core reserve principle would be best under this alternative.

Alternative D would similarly be the least desirable from the standpoint of conserving and managing wildlife and fulfilling international treaty obligations. Conversely, however, this alternative would provide the most benefits to fall-migrating and breeding shorebirds.

The markedly higher acreages of wetland-habitat during the late spring and early summer, along with higher access to wetland-habitat and additional facilities, this alternative would provide the most benefits for wildlife observation and environmental education during these seasons. However, on balance, the achievement of the public-use purpose would be impaired under this alternative due to very few if any hunting opportunities being provided in most years. Therefore, of the alternatives considered, this would be the least desirable from the public-use standpoint.

Implementation of Alternative D would impair the Service's ability to achieve the 14,000-acre wetland-habitat target, and thus would compromise the achievement of the 25,000-acre wetland-habitat target for the Lahontan Valley. Up to an estimated 16,300 acre-feet per year of additional water would have to be secured to attain a long-term average of 14,000 acres of wetland-habitat on Stillwater NWR. This would require additional NEPA analysis.

4.11 CUMULATIVE EFFECTS

The cumulative impacts analysis considers possible impacts to the environment from past, present, and reasonably foreseeable future actions or activities. A variety of interacting factors, identified below, are expected to have cumulative impacts on environmental resources in the study area. The following assessment focuses on the cumulative impacts on acreage and condition of wetland-habitat, migratory bird populations, lower Truckee River and Pyramid Lake resources, opportunities for wildlife-dependent recreation, Newlands Project operations, air quality, local economy, Indian trust assets, and cultural resources.

The actions and other factors considered in this cumulative impact analysis include:

- Regional, flyway, and hemispheric effects on migratory birds (past, present, future).
- Upper Carson River water use (past, present, and future).
- Water use in the Carson Division (past, present, and future).
- Mining during the Comstock era (past).
- Closure of highly contaminated drains (past, future).
- 1988 OCAP (past action).
- Acquisition of water rights for Lahontan Valley wetlands (past, present, future).
- Recovery plans for endangered and threatened Pyramid Lake fish.
- 1997 Adjustments to OCAP (past, present, future).
- Protests of water-right transfers.
- Truckee River Water Quality Agreement (future).
- Truckee River Operation Agreement, or TROA (future).
- Newlands Project Recoupment (future).
- U.S. Army Corps of Engineers study – flood control for the City of Fallon (potential future).
- Transfer of Carson Lake (future).
- Growth and diversification in Churchill County (past, present, and future).
- Climatic variability (past, present, and future).

More detailed information on many of the above actions can be found in the WRAP EIS (USFWS 1996a), Adjusted OCAP (USDI 1997), and the Truckee River Operating Agreement Draft EIS (USDI and State of California1998).

4.11.1 Primary Wetland-habitat Acreage

Historically, an estimated 410,000 acre-feet per year on average flowed down the Carson River into the Lahontan Valley, which sustained an estimated average of up to 150,000 acres of wetland-habitat in the valley (Kerley et al. 1993). Even in the driest of years, the volume of water flowing into the Lahontan Valley would have been sufficient to create annual peaks of 50,000 acres of wetland-habitat in the valley. Although climatic variability is a factor affecting wetland-habitat, it is an important part of the natural functioning of the wetland system.

The major factors that significantly altered the volume and timing of waterflow into the Lahontan Valley wetlands were diversions from the upper Carson River (agricultural, municipal, and industrial uses), construction and operation of Lahontan Reservoir, and water use in the Carson Division (for agricultural, municipal, and industrial uses). Beginning in the early 1900s, diversions from the Truckee River offset adverse impacts to the wetlands to some degree, but also contributed to more land being put into agricultural production in the Carson Division. This lowered the amount of freshwater going to the wetlands, but increased the amount of drainwater flowing into them. Unregulated diversions from the Truckee River also allowed water to be released from Lahontan Reservoir during winter for hydropower generation, which ultimately offset some of the impacts to Lahontan Valley wetlands because much of this water ended up in the wetlands. Winter hydropower generation ended in the late 1960s. Approval of the 1988 OCAP by the Secretary of the Interior in effect reduced the offsetting effects of Truckee River water. As a consequence, prior to any water rights being acquired for the Lahontan Valley wetlands, it is estimated that an average of about 42,000 acre-feet of water would flow into the primary wetland areas, an overall reduction of about 90 percent. Assuming a wetland demand of five acre-feet per acre per year, this would result in a long-term average of about 8,400 acres of wetland-habitat remaining in the primary wetland areas (an estimated 4,700 acres on Stillwater NWR). Except in spill years, these wetlands would have been maintained solely by agricultural drainwater, which would have lead to contaminant problems. Although climatic variability is currently a major factor that influences the amount of wetland-habitat in the Lahontan Valley, the severity of these effects is a consequence of alterations to the Carson River's hydrology. For example, during the recent drought, the Carson River basin produced enough water each year (over 150,000 acre-feet of water even in the driest years), which would have sustained an average of more than 25,000 acres of wetland-habitat in the Lahontan Valley during this period.

Reduced volumes of water into Lahontan Valley wetlands has also resulted from construction and operation of irrigation canals and drains in the Carson Division of the Newlands Irrigation Project, which prevent large volumes of water from reaching the wetlands. Where natural seasonal-peak flows of the Carson River into Stillwater Marsh were on the order of several thousand cfs upwards to 20,000 or more cfs, the maximum capacity of the canals and drains leading to the marsh is less than 450 cfs from several different points of entry. Similarly, a maximum of only 800 cfs can reach the lower Carson River below Sagouspe Dam.

In 1991, freshwater began to be delivered to the Lahontan Valley wetlands, after the first water rights had been acquired by the Nevada Waterfowl Association. The wetlands water-rights acquisition program will eventually maintain a long-term average of about 25,000 acres of primary wetland-habitat in the valley (including 14,000 acres on Stillwater NWR). At present, sufficient water rights have been acquired to supplement drainflows and spill-water to sustain a long-term average of about 12,500 acres of primary wetland-habitat, of which about 7,500 acres would be in the Stillwater Marsh.

Adjustments to the 1988 OCAP, adopted in 1997, are anticipated to offset a small amount of the benefits of the water-rights acquisition program by reducing the number of spill years from one in three years to one in four years, and slightly reducing headgate deliveries and drainwater flows, but it is also anticipated that future modifications to the Service's water-rights acquisition program could be made to minimize these effects (USDI 1997). To the extent that challenges to water-right acquisitions and transfers to Stillwater NWR are successful, future increases in wetland-habitat acreage would not be as high as anticipated. Alternative C of this Draft EIS is not expected to hinder the attainment of the 25,000-acre primary wetland-habitat target. Other future actions that could possibly increase costs, delay, or hinder the attainment of the required 25,000 acres of wetland-habitat include Newlands Project Recoupment, increased recycling of agricultural drainwater, and efforts by the U.S. Army Corps of Engineers to reduce flood potential in the City of Fallon. Depending on how the flood-control project is designed, it could also increase the flow of water to Stillwater NWR (including the alternative boundaries of Stillwater under Alternatives C and D), which would contribute toward the attainment of the 25,000-acre target. Enlarged canals leading to Stillwater NWR would enhance the Service's ability to achieve refuge purposes and to achieve the 14,000-acre wetland-habitat target. The Truckee River Operating Agreement, now in draft, could potentially slightly offset benefits of the Lahontan Valley water-rights acquisition program (an estimated 0.1 percent fewer wetland-habitat acres).

4.11.2 Condition of Wetland-habitat

The composition of basin wetland-habitat generally parallels the above discussion; i.e., as wetland-habitat declines, the amount of each wetland type also declines. However, the proportional amount of a few basin wetland-habitat types have declined considerably since pre-Newlands Project times, including deep-water habitat (primarily at Carson Lake, but also in Stillwater Marsh), and shallow unvegetated habitat and shallow emergent marsh (annually in Carson Sink). The reductions, or loss, of these habitats are consequences of the loss of Carson Lake as a lake, deeper channels in Stillwater Marsh being filled in by sediments, and Carson Lake only receiving water when Lahontan Reservoir spills. Prior to the water rights being acquired for wetlands, the loading of total dissolved solids and contaminants had increased significantly because drainwater replaced freshwater inflows in most years. Closure of Hunter Drain, formerly along Hunter Road, reduced some of the adverse impacts of drainwater entering the refuge. The permanent closure of the TJ Drain would eliminate a substantial source of poor quality water entering Stillwater NWR, which would improve water conditions as a consequence. Furthermore, total dissolved solids and contaminants in wetland inflows is anticipated to decline as additional water rights are acquired. However, mercury contamination could potentially increase if the volume of spill-water reaching Stillwater Marsh and Battleground Marsh increases under Alternatives C and D.

The degradation of riparian habitat along the lower Carson River also is, in large part, due to significantly lower volumes of water reaching this part of the river when spills occur, and the significantly reduced frequency of flooding. Aside from the construction of Lahontan Reservoir, which had major consequences on the lower Carson River, adoption of the 1988 OCAP further restricted water flows to the lower river. Under the 1988 OCAP, the lower river received water on average in one of three years, but the 1997 adjustments reduced this to an average of one of four years. Due to Lahontan Reservoir and operation of the Newlands Project, the timing of flood flows is later than would occur under natural conditions. Mercury is an ongoing problem in the lower Carson River. Past livestock grazing is another major contributing factor to the degradation of riparian habitat and the existing livestock grazing program maintains the habitat in poor condition. The introduction of saltcedar, Russian olive, and other nonnative vegetation is yet another major contributor to the degraded habitat conditions along the lower Carson River. (Appendix N)

Extension of the Stillwater NWR boundary, and initial riparian restoration efforts under Alternatives C and D, would halt further degradation of the riparian zone and would result in improvements in localized areas. To the extent that pre-Newlands Project water rights and the appurtenant lands are acquired (water rights to be used to restore the riparian zone) along the lower Carson River, the potential for restoring this habitat would increase. To the extent that additional lands are acquired along the river within the Alternative C and D boundaries, more riparian habitat could be protected from livestock grazing, which would further benefit native riparian vegetation. Any reductions in the frequency or volume of spillwater reaching the lower Carson River would offset benefits associated with the Alternatives C and D. Depending on how it is designed, the U.S. Army Corps of Engineers' project to reduce the flood potential for the City of Fallon, more, or less spill-water would reach this part of the river.

4.11.3 Migratory Bird Populations

Migratory bird populations that use the Stillwater NWR Complex are affected by a host of other factors beyond those that affect basin wetland, riparian, and other habitats on the refuge complex. The diversity of birds on the Stillwater NWR Complex is affected by land-use practices throughout the Western Hemisphere. Many species of birds that use the refuge complex only spend part of their time on the area. Although habitat conditions on the refuge complex plays a large role in determining the level of use by any given species, the overall population size of the species in the Pacific Flyway is a dominant factor affecting abundance on the refuge complex. For instance, if a particular species or given population of a species, is low, its abundance on Stillwater NWR will correspondingly be low, regardless of habitat quality on the refuge.

Some species of migratory birds have been adversely impacted by significant reductions in the amount of habitat, degradation of habitat, and pesticide use and other contaminant problems in other parts of North, Central, and South America. In the Great Basin in particular, wetland-habitat has declined by an estimated 80 percent and riparian cottonwood and other riparian communities have been significantly impacted by land use practices since the mid 1800s, which likely has affected the same populations of migratory birds that use the Stillwater NWR Complex.

On a local level, some species have benefitted from changes in the habitat in the Lahontan Valley. So long as adequate nesting habitat remains available on Stillwater NWR and other Lahontan Valley wetlands, surrounding land-use practices, such as flood irrigation, appear to have increased the white-faced ibis population. Thus, use of the refuge by white-faced ibis may be higher now than it was prior to agriculture in the Lahontan Valley. It has also been speculated that common ravens are more abundant in the Lahontan Valley now as compared to natural conditions, although this is unsupported as yet, likely due to higher food availability during winter. To the extent that raven populations are higher than they were under natural conditions, depredation of waterbird nests may be higher than under natural conditions, regardless of nesting-habitat quality.

Another factor that has had a considerable effect on Stillwater NWR wetlands and other Lahontan Valley wetlands is public use. Providing opportunities for hunting, birdwatching, and other wildlife-dependent recreation on Stillwater NWR and WMA and the attachment that these users developed for Lahontan Valley wetlands may ultimately have led to the increasing amount of wetland-habitat on Stillwater Marsh. It is quite possible that, without efforts by Western Nevada-based coalition of hunting, environmental, and other conservation groups, the Service would not be acquiring water rights for Stillwater NWR. The effect of increasing the long-term wetland-habitat acreage in the Lahontan Valley was evaluated in the WRAP EIS (USFWS 1996a), and therefore is not addressed further in this Draft EIS.

Each of the different alternatives considered in this Draft EIS would affect migratory birds in different ways. These are identified earlier in this chapter. In general, Alternative B would enhance fall and wintering waterfowl populations beyond the benefits anticipated under Alternative A, but would have fewer benefits to migrating shorebirds and similar benefits to breeding waterbirds as compared to Alternative A. Alternative C would enhance breeding habitat for waterbirds and fall migration habitat more so than anticipated under Alternative A, but would have neutral or slightly lower benefits to fall and winter waterfowl than anticipated under Alternative A. Alternative D would have fewer benefits to most migratory bird groups as compared to Alternative A, except that it would benefit fall-migrating shorebirds more than under Alternative A.

4.11.4 Lower Truckee River and Pyramid Lake Resources

4.11.5.1 Pyramid Lake

In the early years of record (1880 to 1910), the water level of Pyramid Lake remained fairly stable, as Truckee River inflow and evaporation were roughly in balance (California, Department of Water Resources, 1991). From a peak of about 3,887 feet in elevation in 1870, the lake level began to decline in 1910 due to increased upstream diversions and Newlands Project operations which diverted an average of 239,700 acre-feet per year from the Truckee River between 1910 and 1966 (Federal Water Master's Gaging Station, Sierra Hydrotech data, 1980). In 1967, when the water level reached the lowest recorded elevation of 3,784 feet (a decline of about 103 feet), operating criteria for the Newlands Project curtailed winter power generation, which reduced Truckee River diversions. Fewer diversions to the Newlands Project and record runoff from the Sierras during the 1980s resulted in the water level in Pyramid Lake to increase by about 30 feet. Lake levels again dropped during the late 1980s and early 1990s, but the level is rising again due to record runoff from the Sierras.

Adjustments to the 1988 OCAP, implemented in 1997, are anticipated to raise water levels in the lake by about nine feet. The Truckee River Operation Agreement and Truckee River Water Quality Agreement are anticipated to result in further benefits to Pyramid Lake. The Preferred Alternative is estimated to slightly increase Truckee River flows below Derby Dam, but effects on Pyramid Lake would not be measurable.

4.11.4.2 Fish Populations

Cui-ui were Federally-listed as endangered in 1967 due to a sharp decline in numbers and an aging population (USFWS 1992), a consequence of diverting large volumes of Truckee River water to the Newlands Project (at Derby Dam) and other upriver diversions. Implementation of OCAP (USBOR 1997) is anticipated to increase the population of cui-ui in the long term. Full implementation of the 1988 OCAP with 1992 assumptions would result in an estimated 217,100 cui-ui at the end of the simulation period. (The number of adult female cui-ui that would exist at the end of a 95-year (1901-1995) computer simulation is used as an index of the reproductive response of the cui-ui population to varying instream flow and Pyramid Lake levels.)

Adjustments to OCAP (USBOR 1997) and the Lahontan Valley water-rights acquisition program (USFWS 1996a) will result in further long-term increases in the number of adult female cui-ui. Under the Adjusted OCAP and given the volume of water rights acquired to date for the wetlands, and assuming they are transferred to the wetlands and delivered according to the agricultural delivery pattern, an estimated 692,200 adult female cui-ui would exist at the end of the 95-year simulation period, a 220 percent increase. Under baseline conditions of this Draft EIS (Alternative A; completion of water-rights acquisition program delivered to wetlands according to the agricultural delivery pattern), the cui-ui index would more than double to an estimated 1,214,500. As a consequence of additional reductions in Truckee River diversions resulting from implementation of Alternatives B, C, or D, the cui-ui index would increase to an estimated 1,209,400, 1,274,100, or 1,365,261, respectively. Cumulatively, this would be nearly a 500 percent increase (or, in the case of Alternative D, more than a 500 percent increase) over long-term conditions anticipated under the 1988 OCAP with 1992 assumptions. Implementation of a Truckee River Operating Agreement and Truckee River Water Quality Settlement Agreement, now in draft stages, and Newlands Project Recoupment, pending a court decision, could further enhance the cui-ui population. The Truckee River Operating Agreement is expected to change the timing of flows in the Truckee River to provide more water during cui-ui spawning seasons. Water rights acquired as part of the Truckee River Water Quality Settlement Agreement would further enhance flows in the lower Truckee River, improve water quality in the lower river, and increase the level of Pyramid Lake. Recoupment would result in more water for the lower Truckee River, thereby facilitating fish passage across the Truckee River delta, and

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would further enhance cui-ui spawning and rearing habitat, and increase the frequency of cui-ui spawning opportunities.

Due to the combined effects of Truckee River water diversions at Derby Dam, pollution, commercial harvest, and introductions of nonnative species, the original Pyramid Lake Lahontan cutthroat trout population was extinct by 1944 (USFWS 1995). Lahontan cutthroat trout have been stocked in Pyramid Lake since this time (this practice actually began three decades before the original population became extinct). Buchanan (1987, as cited in USFWS 1995) estimated that it would take 478,500 acre-feet/year of water to provide suitable spring spawning habitat for Lahontan cutthroat trout in the lower Truckee River. This volume of flow would be needed nearly on nearly an annual basis. From 1918 through 1970, the average annual flow was roughly 300,000 acre-feet, with approximately 250,000 acre-feet being diverted at Derby Dam to the Newlands Project (USFWS 1992).

Full implementation of the 1988 OCAP with 1992 assumptions would result in an estimated average of 441,300 acre-feet of lower Truckee River flows (USDI 1997). Completion of the water-rights acquisition program for Lahontan Valley wetlands would result in this amount increasing to an estimated average of 458,300 acre-feet/year (USFWS 1996a), and cumulative with Adjusted OCAP (USBOR 1997), would be anticipated to increase to an estimated long-term average of 480,500 acre-feet/year, which is above the amount estimated for providing suitable spawning habitat (recognizing this is a long-term average). As a consequence of additional reductions in Truckee River diversions resulting from implementation of Alternatives B, C, or D, lower Truckee River flows would increase further to long-term estimates of 496,140; 497,210; or 498,140 acre-feet/year, respectively. Flows of at least 478,500 acre-feet/year would be anticipated in most years, and Alternatives C and D would further benefit Lahontan cutthroat trout by resulting in slightly higher flows during July through December, a critical period for trout maintenance. Implementation of a Truckee River Operating Agreement and Truckee River Water Quality Settlement Agreement, now in draft stages, would further enhance the Lahontan cutthroat trout population. The actual effects are described above for cui-ui.

4.11.5 Other Wildlife Issues

4.11.5.1 Mosquito Populations

The Lahontan Valley historically was a fertile ground for several species of mosquitos, with seasonally flooded wetlands along the banks of the Carson River as well as Stillwater Marsh, Carson Lake, and other wetlands. The significant reductions in acreage of Lahontan Valley wetland-habitat discussed previously reduced natural breeding habitat for mosquitos, but created other breeding areas (e.g., agricultural drains, seasonally flooded pasture). However, the Churchill County Mosquito Abatement District controls mosquitos in many of these more recent habitats. In total, the net result of changes in water distribution was probably a reduction in habitat, and thus fewer mosquitos. The wetlands water-rights acquisition program, once completed, will create additional breeding habitat for mosquitos northeast of the city of Fallon. The Preferred Alternative of this Draft EIS may increase the suitability of wetland-habitat for some species of mosquitos beyond baseline conditions due to peak acreages in spring followed by declining water levels later in the spring and summer.

4.11.6 Opportunities for Wildlife-Dependent Public Uses

4.11.6.1 Waterfowl Hunting

In many ways, cumulative effects on waterfowl hunting opportunities in the Lahontan Valley parallel the cumulative impacts on wetland-habitat and waterfowl populations. Use of Stillwater WMA (including areas now inside Stillwater NWR) for waterfowl hunting was high in various periods during the 1950s, 1960s,1970s, and into the early 1980s. Until the late 1960s, water flowed into Stillwater Marsh during winter months as a consequence of winter hydroelectric power generation which made use of Truckee River water. Although the curtailment of winter power generation at Lahontan Reservoir eliminated the flow of large volumes of fresh water into Stillwater Marsh during winter months, most of the eight years following the curtailment this supply of water were high-water years, many of which saw precautionary releases or spills from Lahontan Reservoir.

Beginning with further reductions in Truckee River diversions to the Newlands Project in the late 1980s and additional actions to increase water-delivery efficiency in the project, as a consequence of the 1988 OCAP, wetland-habitat acreage in Stillwater NWR and WMA declined further. A compounding factor was the drought that lasted from 1987 through 1992. During the drought, very little of the water flowing down the Carson River made it to the wetlands, and the little that did was in the form of drainwater. This brought wetland-habitat acreage in Stillwater NWR and WMA to less than 500 acres in one year. No waterfowl hunting occurred on Stillwater NWR this year due to very limited habitat available for waterfowl.

Since the drought, the number of people interested in hunting has not rebounded to the numbers prior to the drought. Other factors include a downward trend nationwide in the per capita number of hunters. However, it is anticipated that increased acreage and reliability of wetland-habitat on Stillwater NWR and other primary wetland areas in the Lahontan Valley will contribute toward an increase in hunter numbers. The degree of benefits depends in part on how Stillwater NWR is managed, which is the subject of this Draft EIS. Under all the alternatives considered in this Draft EIS, except Alternative D, the water-rights acquisition program would have large benefits to waterfowl hunters, with Alternative B providing the most benefits and Option 1 of Alternative C providing the least. Another consequence of the water-rights acquisition program is the enhanced waterfowl hunting opportunities that will be available at Carson Lake, especially to the extent that fall and winter wetland-habitat are emphasized. Mine dewatering activities in the Humboldt River drainage, anticipated to last more than 10 years, will also contribute to hunting opportunities in the area by providing additional wetland-habitat in the area of Humboldt Sink and Humboldt Slough.

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4.11.6.2 Wildlife Observation and Photography

National trends for nature tourism have been steadily on the rise (USDI et al. 1996). Given the limited amount of data collected for Stillwater NWR on these activities, a definitive number is not available. However, an assumption could be made that the number of these visitors would grow to mirror the nationwide direction. The 1987-1992 drought no doubt had an effect on viewing wildlife in the form of wetland-dependent species, but the upland ecology did not suffer the same level of effects as the wetland areas and maintained its compliment of species, and those interested in viewing a Great Basin ecosystem at work would have had no problem. With the implementation of an active water rights acquisition program, the more stable wetland communities will attract a constant viewing public. Variety is an important component for many of these viewers, so added facilities and opportunities provided elsewhere in the valley would have negligible effects.

4.11.6.3 Environmental Education and Interpretation

Environmental education and interpretation has occurred within the Stillwater NWR since the management area was established in 1948 and a meager staff was in place. However, it has never been a priority consideration and was performed on an as-warranted, as staff time allowed basis. The program began to grow in the early 1990s corresponding to a heightened interest in the Lahontan Valley wetlands and in response to environmental education being named one of the purposes of Stillwater NWR. With the passage of the Refuge System Improvement Act, of 1997, these uses have taken on a new importance and will be facilitated at a much greater level. Opportunities will abound on Stillwater NWR.

4.11.6.4 Fishing

Fishing was a very common activity on Stillwater NWR and WMA during the 1950s and 1960s when water flowed into Stillwater Marsh and other wetlands during winter hydroelectric power generation at Lahontan Reservoir. During this period, considerable amounts of fresh water flowed into the refuge during winter months, which maintained relatively freshwater conditions in parts of the Stillwater Marsh. In 1959, "approximately 4,000 fisherman use days occurred..." (USFWS 1960) within Stillwater NWR and WMA, and much of this use occurred in West Marsh.

When winter power water no longer flowed into the refuge in the late 1960s, water conditions began to decline. In the 1976 Annual Narrative Report for the Stillwater NWR Complex (Refuge files), it is noted that the large bass fishery that once occurred on the refuge had declined and that very little fishing continued in Stillwater Marsh. By that time, most of the fishing took place in the Indian Lakes area. Then beginning with further reductions in Truckee River diversions to the Newlands Project in the late 1980s, as a consequence of the 1988 OCAP, wetland-habitat acreage in Stillwater NWR and WMA declined further and the freshness of the marsh also declined due to reliance on drainwater in most years. A compounding factor was the drought that lasted from

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the mid-1980s through the early 1990s, which brought wetland-habitat acreage in Stillwater NWR and WMA to less than 1,000 acres. Populations of sport fish had declined significantly.

Overlain on top of these effects that mercury contamination of the Carson River system has had on fishing in the Lahontan Valley. Between 1859 and 1900, mercury amalgamation was used in the milling of gold and silver ore from the Comstock Mining District near Carson City, Nevada (Smith 1943). As much as 7,500 tons of elemental mercury may have been lost during milling operations (Bailey and Phoenix 1944), and most was discarded in mill tailings or discharged directly into the Carson River and its tributaries. Since this time, mercury has spread throughout the Carson River drainage below the Virginia Mountain Range, including the Lahontan Valley wetlands. The State of Nevada has issued a health advisory noting that eating any fish caught in the Lahontan Valley is not safe due to mercury contamination.

As a consequence of the above-described factors, very few people have been fishing in Stillwater NWR and WMA since the drought, even in the Indian Lakes area where most of the fishing has occurred during the last 10 years. Although the number of people fishing on Stillwater NWR appears to have increased slightly over the last few years, the exclusion of fishing on Stillwater NWR under the action alternatives due to mercury contamination would not contribute substantially to the already depleted opportunities for fishing in the Lahontan Valley.

4.11.7 Other Uses and Resources

4.11.7.1 Newlands Project Operations

Several past and ongoing activities and actions, in combination, have or are anticipated to contribute to higher Newlands Project delivery efficiency rates: 1988 OCAP, Adjusted OCAP, implementation of Naval Air Station-Fallon's modified land management plan, growth of Churchill County (including the Naval Air Station-Fallon expansion), and wetlands water-rights acquisition program (USFWS 1996a). Changes in the seasonal delivery pattern for Stillwater NWR, as proposed under Alternatives C and D would contribute further to this rising efficiency rate, while Alternative B could slightly detract from it.

The Adjusted OCAP (USBOR 1997) lowered Lahontan Reservoir storage targets below those identified in the 1988 OCAP. Conversely, the acquisition of water-rights for Lahontan Valley wetlands is anticipated to result in somewhat higher storage volumes in early summer and fall (USFWS 1996a). Furthermore, by shifting water deliveries to earlier in the year and possible winter deliveries, storage volumes in Lahontan Reservoir during the fall would increase further (Alternatives C and D), although early summer storage volumes could remain nearly the same (Alternative C) or could be lower (Alternative D), than would be anticipated under baseline conditions. If implemented, the Truckee River Operating Agreement could further reduce Lahontan Reservoir storage volumes. Newlands Project Recoupment, if decided in favor of the Federal government, and to the extent that Truckee River diversions are reduced, could potentially lower storage volumes in Lahontan Reservoir. The Truckee River Water Quality Settlement Agreement would have negligible effects on the Carson Division.

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4.11.7.2 Air Quality

Sources of airborne particulates in the area of Fallon include the surrounding desert lands (a major source); agricultural plowing, disking, and burning; dust blown off of dirt roads; combustion from vehicles and home heating units; and trashing burning. As urban expansion continues and more farmland is converted to residential and other developments in the Fallon area, degradation of air quality due to agricultural activities should decline in the immediate vicinity of Fallon, although urban-related air quality problems related to such things as trash burning, dust from roads, combustion from vehicles and home-heating units, and construction activities would increase. The water-rights acquisition program, initiated in 1990, would also result in less particulates being released into the air from plowing, disking, and burning, short term increases in wind erosion may result to the extent that vegetation cover on vacated farmland declines (USFWS 1996a). However, although this could result in short term impacts to air quality, the prevailing winds are out of the west and southwest which would minimize any potential problems because the acquired farmlands are primarily to the east and south of Fallon.

Under Alternatives B and C, prescribed burning could reduce air quality slightly, but only during a few days each year. The amount of burning proposed is small compared to the amount of agricultural and other burning that occurs in the vicinity of Fallon.

4.11.7.3 Local Economy. As a consequence of the ongoing wetlands water-rights acquisition program, agricultural production, agricultural sales, and agricultural-related jobs will continue to decline in Churchill County. Another major impact to the agricultural sector of Churchill County is encroachment of residential development into the heart of area's farmland. These impacts are in addition to those incurred by the 1988 OCAP and adjustments to it in 1997. Newlands Project Recoupment, depending on how it is carried out, could also affect the local economy. In addition, the Truckee River Water Quality Settlement Agreement could lead to several thousand acres of other agricultural lands in the region being taken out of production, further affecting the agricultural sector. Alternatives B, C, and D of this Draft EIS would slightly impact agricultural production in Churchill County due to cattle grazing being phased out of the Federal lands within the respective boundary alternatives. Livestock grazing would continue in the areas not incorporated into the refuge under Alternatives B and C, and limited livestock grazing would continue under these two alternatives, and impacts to the local economy would be slight. Any changes in livestock grazing practices on Carson Lake, pending a transfer to the State of Nevada, could also affect livestock grazing opportunities in the Lahontan Valley.

Some of the reductions in agricultural economic activity and jobs due to existing water-rights acquisitions for wetlands, residential development, and other future actions will be at least partially offset by increased economic activity (including new home construction) and jobs resulting from income gains associated with water-rights purchases, Naval Air Station-Fallon expansion, construction, and economic diversification. Furthermore, increased visitation of Stillwater NWR and Carson Lake due to increased wetland acreage and enhanced visitor facilities would contribute to the local economy.

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4.11.7.4 Indian Trust Assets and Cultural Resources

Pyramid Lake and lower Truckee River resources are anticipated to benefit slightly from higher Newlands Project efficiencies due several past and ongoing actions (1988 OCAP, 1997 Adjusted OCAP, water-rights acquisition program for Lahontan Valley wetlands), thus benefitting the Pyramid Lake Paiute Tribe. Changes to the water-delivery schedule for Stillwater NWR under Alternatives C and D of this Draft EIS would further benefit these resources. To the extent they are implemented or undertaken, these resources would also benefit further from the Truckee River Operating Agreement, Truckee River Water Quality Settlement Agreement, and Newlands Project Recoupment. The acquisition of water rights for wetlands on the Fallon Paiute-Shoshone Indian Reservation would enhance trust resources on the Fallon Paiute-Shoshone Indian Reservation.

The protection of cultural resources on Stillwater NWR, Stillwater WMA, and Fallon NWR is anticipated to be enhanced by several ongoing actions, but could also be negatively affected by others. The continued acquisition of water rights for Stillwater NWR wetlands will enhance the preservation of prehistoric cultural resources at Stillwater NWR as a consequence of more water covering cultural resource sites in Stillwater Marsh. Closing portions of the marsh to visitor use, or restricting visitor access (e.g., boating restrictions, walk-in-only area during hunting season, additional sanctuary, and requiring people to stay on roads during the breeding season) will add to the protection of cultural resources. Shifting the water-delivery pattern to one approximating a natural flow pattern (Alternatives C and D) or one emphasizing late summer deliveries, would result in benefits of the acquisition program not being as high as they would if the wetland water levels remained more static through the year. Population growth in Churchill County could adversely impact cultural resources as a consequence of land development in some areas and as a consequence of more people recreating in the area around Fallon, including the Stillwater area.

4.12 POSSIBLE CONFLICTS WITH AGENCY, TRIBAL, COUNTY OR STATE PLANS OR POLICIES

Alternative C does not appear to markedly conflict with the 1990 Churchill County Master Plan, as amended in 1995. The Policy Plan for Public Lands included in the 1990 Master Plan specified that Stillwater WMA should be managed primarily for wildlife values. Potential conflicts include additional regulations on recreational activities and slightly reduced road access, although these changes under Alternative C does not appear to deviate substantially from Churchill County's Policy Plan for Public Lands. The policy, which recognizes that there are conflicts between livestock grazing and wildlife, states that livestock grazing should continue on public rangelands where compatible with multiple use objectives.

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4.13 UNAVOIDABLE ADVERSE EFFECTS

Implementing Alternative C may result in some adverse environmental effects that could not be avoided, even with mitigation measures. In the previous sections of this chapter, the effects of Alternative C on the various components of the Lahontan Valley environment, including the social and economic environment, were identified. Possible relevant and reasonable mitigation measures were described in general terms for each of the major affected resources. Since the Service cannot ensure or determine that the identified mitigation measures will be fully implemented, there are likely to be situations where unavoidable effects will occur.

Although the amount of wetland-habitat to be retained through the fall and winter would be increased considerably from existing conditions, it would not increase to the extent that it would under baseline conditions (Alternative A). Given the interest in waterfowl during the fall and winter, this would be an adverse impact, as compared to baseline conditions. This lesser amount of fall and winter wetland-habitat could result in fewer waterfowl during this time of year.

Construction of an administrative and visitor facility would have unavoidable adverse impacts to the immediate site on which it would be located. Enhanced facilities for refuge visitors, including the visitor facility, would increase the number of people visiting the refuge. Even under a carefully designed program, increased visitation would result in higher levels of disturbance to wildlife, but most of these would occur in localized areas. Although this is an unavoidable adverse impact (given the emphasis on encouraging and facilitating public-use), the public-use program under Alternative C would be designed to minimize these effects.

Use of pesticides to control saltcedar and other invasive vegetation could have adverse, short-term impacts to native vegetation. These impacts would be minimized through prescription and through the development and implementation of an integrated pest management program. Most direct impacts of pesticides would occur to target species. Smoke from a limited amount of prescribed burning may negatively impact visual quality for some people for a short time each year, fewer than five days per year.

Hydropower generation would be decreased and adversely impacted as a result of the Service's action. The loss of revenues associated with hydropower generation could be mitigated. New power generating facilities could be constructed, but this is highly unlikely because hydropower generation is not an authorized purpose for Newlands Project water electric power generation is considered incidental to other water uses. It is unlikely that power loss could be mitigated under this action alone, and therefore it is identified as one of the unavoidable adverse effects that would result as a consequence of implementing Alternative C.

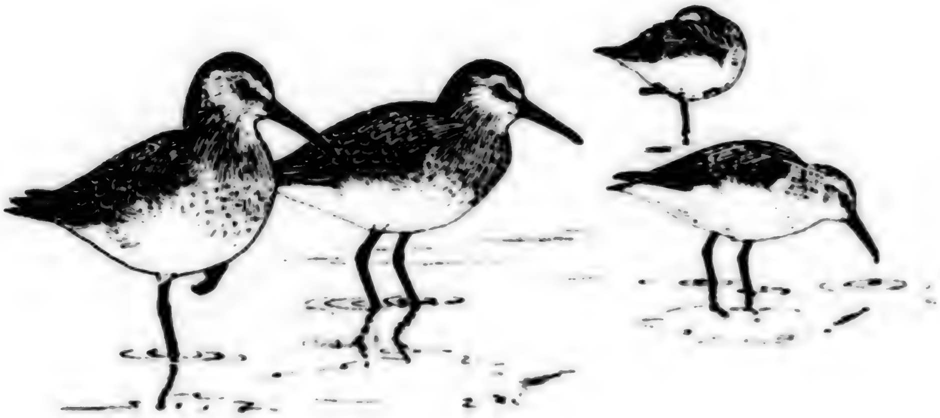
4.14 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

An irreversible commitment of resources results from an action that changes resources to the extent that they are either lost or would take an extremely long time to replace or recover. Any accidental damage or loss of a cultural resource would constitute an irretrievable commitment of resources. Management actions on Stillwater NWR, regardless of alternative selected, would be carried out in ways that ensure this would not happen. A potential irreversible commitment of resources could include areas that are not within the Alternative C boundary of Stillwater NWR. Once the boundary is revised, it would be difficult to change it in the future. The level of protection of lands not included in the boundary would be less than that of lands within the refuge.

An irretrievable commitment of resources refers to losses of production or use of a renewable resource for a period of time. This can occur when land or resources are allocated to other uses during this period. Elimination of livestock grazing from extensive areas now within Stillwater NWR, Stillwater WMA, and Fallon NWR constitutes and irretrievable loss to the livestock grazing industry because vegetation growing on the lands included in an approved refuge boundary would not be consumed by livestock into the foreseeable future under Alternative C. Although this vegetation would not be eaten by livestock, the change in land use practices would allow this vegetation to once again be used by wildlife for nesting, thermal cover, hiding cover, and forage, as well as enhancing the health of the land through soil formation and restoration of native plant communities. Road closures, increased boating restrictions, and any additional areas closed to hunting and other activities would similarly constitute an irretrievable loss of resources for some members of the public visiting the refuge in the future. For example, foregone opportunities would be those opportunities that could now be experienced in areas open to the public for a variety of opportunities, but would be either closed to public use (e.g., Lead Lake and West Marsh under Option 1 of Alternative C) or would be unavailable for certain uses such as boat-in hunting (e.g., West Marsh and Swan Lake under Option 2 of Alternative C). The latter presents an example of expanded opportunities for other members of the public (e.g., those wanting to hunt in an area not accessible by boats). Any opportunities that now may exist for future leasing of geothermal resources in the Stillwater known geothermal resources area (KGRA) would be irretrievable upon revising the boundary of Stillwater NWR to the extent the overlying Federal lands are encompassed within the approved boundary.

4.15 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Long-term productivity, in the case of Stillwater NWR, refers to the capability of the land to provide resources into the future. One of the intents of Alternative C is to enhance the long-term productivity of the refuge ecosystem to contribute toward the maintenance of healthy populations of native wildlife into the future. Long-term objectives require short-term actions, such as water management, maintenance of delivery canals, and prescribed use of herbicides to control saltcedar.



LIST OF PREPARERS

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LIST OF PREPARERS

	Position while on Planning Team	Degrees	Years of Exp.	Summary of Contributions
Core Planning Team				
Dan Walsworth	Nevada and Southern California Refuges Supervisor	BS-Wildlife Bio. MS-Wildlife Bio.	23	Oversight and supervision; development of issues, goals, objectives, and strategies (Refuge Manager during initial stages of development—departed December 1998)
Kim Hanson	Refuge Manager	BS-Wildl.& Fisheries MS-Biology	23	Oversight and supervision, coordination, review, refinement of strategies
Robert Flores	Deputy Refuge Manager (departed December 1998)	BS- Wildlife Mgt.	20	Development of issues, objectives, and strategies
Anita DeLong	Assistant Manager (departed July 1998)	BS-Zoology MS-Wildlife Sci.	9	Development of goals, objectives, strategies, and impacts; technical appendices
Donna Withers	Assistant Manager	BS-Wildlife Mgt.	17	Review, refinement of Anaho Island NWR goals and objectives
Don DeLong	Planning-team Leader Wildlife Biologist	BS-Wildlife Bio. MS-Wildlife Sci.	10	Coordination of planning process and document preparation; development of issues, goals, objectives, strategies, and impacts; writing; technical appendices, compatibility determin.
Bill Henry	Wildlife Biologist	BS-Wildlife Mgt. MS-Wildlife Mgt.	21	Biological issues, goals, objectives, and strategies; document review
Rob Bundy	Wildlife Biologist	BS-Wildlife Bio MS-Wetlands Eco.	9	Biological descriptions, objectives, strategies, and impacts; writing; technical appendices, analyses, and reports, compatibility determin.
Janet Schmidt	Outdoor Recreation Specialist	BS-Resource Mgt.	5	Public Use descriptions, issues, goals, objectives, strategies, and impacts; writing
Anan Raymond	Regional Archeologist	BA-Anthropology MA-Anthropology	20	Cultural resources descriptions, issues, objectives, strategies, and impacts
Pete Tuttle	Environmental Contaminant Specialist	BS-Aquatic Ecology	18	Contaminant descriptions, issues, objectives, strategies, and impacts
Map Production, Analyses, and Document Preparation				
Tom Cochrane	Geographic Information System (GIS) Specialist	AA-Science, Math, History, Music	10	Map production, GIS analysis
Tom Crawford	Economist, Bureau of Reclamation Bureau of Land Management	BS & MS-Resource and Environmental Economics	18	Socio-economic issues and impact analysis
Mark Pelz	Refuge Planner GIS Specialist	BS-Biology	6	Appendices, document preparation
Loretta McCorkle	Writer Editor	BA-Liberal Studies	3	Editing, document preparation
Matt How	Visual Information Specialist	BA-Art, BA-Biology	18	Cover design, technical drawing, printer prep.

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	Position	Summary of Contributions
Technical Assistance		
Richard Grimes	Supervisory Realty Specialist	Document review, water-rights acquisition land disposal
Delvan Lee	Superv. Engineering Equipment Operator	Document Review
Robert Henderson	Engineering Equip. Operator/Law Enf. Officer	Law enforcement, document review
Dan Dearborn	Fire Management Officer, USFWS, Lakeview, OR	Fire Management Plan
Scott Stenquist	IPM Specialist, USFWS, Portland, OR	Assistance with integrated pest management planning
Steve Caicco	Land Protection Planner, USFWS, Portland, OR	Land Protection Plan
Kevin Kilbride	Assistant Regional Wildlife Biologist, USFWS Vancouver, WA	Data analysis, study design, review
Al Olson	Supervisory Civil Engineer, Bureau of Reclamation, Carson City, NV	Below Lahontan Reservoir modeling and analysis
Lisa Heki	Fisheries Program Supervisor, USFWS, Reno, NV	Assistance in assessing impacts on cui-ui and Lahontan cutthroat trout
Stephanie Byers	Endangered Species Specialist, USFWS, Reno, NV	Assistance in developing Intra-Service Section 7 Evaluation
Elizabeth Caplun-Cochrane	private contractor	Prototype Stillwater Marsh Model

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GLOSSARY

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GLOSSARY

Acre-feet (AF). An acre-foot of water is the amount of water required to cover 1 acre of land to a depth of 1 foot; it is the equivalent of 325,851 gallons.

Alien Species. With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.

Alkalinity. Refers to the extent to which water or soils contain soluble mineral salts. Waters with a pH greater than 7.4 are considered alkaline.

Alpine Decree. The final decree of the U.S. District Court for the District of Nevada in *United States of America* v. *Alpine Land and Reservoir Co.*, Civ. No. D-183 BRT, entered December 18, 1980, and any supplements thereto.

Alternative. Alternatives are different means of accomplishing refuge purposes and goals and contributing to the Refuge System mission (Service Manual 602 FW 1.5).

Animal Unit Month (AUM). The amount of forage necessary to maintain one mature (1,000-pound) cow and calf, or equivalent, for one month.

Annual (plant). A plant living only one year or season.

Appropriated Water. Surface water in an irrigation district that has been assigned or allocated to owners of water rights.

Aquatic. Pertaining to water, in contrast to land. Living in or upon water.

Aquatic Habitat. The physical, chemical, vegetative, and topographic features that occur within the water of lakes, ponds, reservoirs, rivers, irrigation canals, and other bodies of water.

Artifact. An object made by humans; usually in reference to primitive tools, vessels, weapons, etc.

Avian Botulism. A highly infectious disease caused by the bacterium, Pastuerella multocida, transmitted through bird to bird contact

Basin. A depressed area where water flows in, but where surface water does not flow out.

Biotic, or Biological. Refers to the living plants, animals, and other organisms and their activities and relationships, as opposed to abiotic, which refers to non-living parts of the environment.

Biological Control. The use of biological agents in pest control to reduce the population of pest species to acceptable levels. Included are the use of natural enemies (predators, parasites), natural or genetically engineered diseases, attractants, sterilized animals, pheromones, hormones and trap crops.

Biological Diversity (biodiversity). Refers to the full range of variability within and among biological communities, including genetic diversity, and the variety of living organisms, biotic communities, and biological processes. Diversity can be measured in terms of the number of different types of species, biotic communities, and biotic processes and the amount (e.g., abundance, biomass, canopy cover, rate) and structure of each.

Biota. The plant and animal life of a region.

Botulism. See Avian Botulism.

Canal Losses. Seepage, evaporation, and operational spills from main-line canals and regulatory reservoirs.

Carson Division. The Carson Division of the Newlands Project is located entirely within Churchill County; agricultural land in this division is supplied by a combination of Carson and Truckee River water from Lahontan Reservoir.

Carson River Basin. The area which naturally drains into the Carson River and its tributaries and into the Carson River Sink, but excluding the Humboldt River drainage area.

CFR. Code of Federal Regulations.

CFS. Cubic Feet Per Second.

Cholera. A paralytic, often fatal disease of birds resulting from ingestion of toxin produced by the bacterium, Clostridium botulinum.

Community. An assemblage of plants and/or animal populations and associated biotic processes within a particular area.

Compatible Use. A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the Mission of the System or the purposes of the refuge. The term sound professional judgement means a finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of applicable laws. (Refuge System Administration Act, as amended.)

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of a refuge; and provides long-range guidance and management direction to accomplish the purposes of the refuge, contribute to the mission of the Refuge System, and to meet other relevant mandates (Service Manual 602 FW 1.5).

Control. As in the context of controlling nonnative invasive plants or animals, the process of eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of targeted species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.

Core Problem. A concise statement that identifies underlying or root causes of related problems (a *problem statement* as used in Coughlan and Armour 1992).

Cultural Control. The reduction of pest populations through physical manipulations of the environment by manual or mechanical means. Examples include fertilization, mowing, cultivating, fallowing, mulching, crop rotation, timing of planting or harvesting, manipulating water levels, managing wastes, burning, anc certain types of sanitation.

Cultural Resource. The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples) of an area. It includes historical, archaeological and architectural significant resources.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

Cultural Resource Overview. A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field offices background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).

Cumulative Effect. The impact on an environment which results from the combined and incremental impact of more than one action. Cumulative impacts can also result from individually but collectively significant actions taking place over a period of time.

Delivery. Conveyance of water-righted water to a water-users head gate during the irrigation season.

Demand. The amount of water that a water-right holder calls for or requests in any one irrigation season. Under Nevada State law demand should not exceed entitlement.

Deposits. Material that is laid down through the actions of wind, water, ice, or other natural process.

Detritus. An accumulation of decomposing plant and animal remains.

Direct Effects. Effects on the environment that occur at the same time and place as the initial cause or action.

Dissolved-Solids. Particles that are dissolved and suspended in water. See also total dissolved solids.

Disturbance. Habitat Disturbance: in reference to disturbances on vegetation communities, it consists of any activity that has the potential to change vegetation structure and composition (e.g., fire, herbicide application, livestock grazing). Human Disturbance: Any activity that tends to disrupt the normal movement or habits of a particular wildlife species. As defined by Morton (1995), human disturbance is any intentional or unintentional anthropogenic action that elicits a metabolic or behavioral response.

Diversion. A structure in a river or canal that diverts water from the river or canal to another water course.

Diversity. An attribute of a site or area that refers to the number of different items (e.g., species, community types, habitats, or other components of an ecosystem) and the relative abundance of each. It can also refer to the structural complexity of vegetative communities.

Drain. A canal that collects and transports excess water from irrigated farmland.

Drainwater. See irrigation drainwater.

Ecosystem. The sum of all interacting parts of the environment and associated ecological communities within a particular area; an ecological system. Many levels of ecosystems have been recognized. Very few, if any ecosystems are self-contained; most influence, or are influenced by, components or forces outside the system.

Ecosystem Approach. Protecting or restoring the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.

Effect. A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Efficiency. With reference to an irrigation water delivery system, the proportion of the amount of water delivered for irrigation use compared to the total amount of water released to meet that delivery (i.e., amount of delivery divided by amount of release).

Effluent. Waste material discharged into the environment from a wastewater treatment facility.

Emergent Vegetation. Rooted wetland plants that have most of their vegetative (non-root) parts above water.

Endangered Species. Any species that is in danger of extinction throughout all or a significant portion of its range and listed as such by the Secretary of the Interior in accordance with the Endangered Species Act of 1973. Endangered species are afforded protection under the Act as amended and under various State laws for State-listed species.

Entitlement. The annual maximum amount of water which can be delivered to a parcel of land, a product of eligible acres and water duty (expressed in acre-feet).

Environment. The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

Environmental Impact Statement (EIS). A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Ephemeral. Pertains to streams, lakes and wetlands that exist temporarily each year.

Ethnography. The branch of anthropology that deals descriptively with specific cultures, especially those of non-literate people.

Evapotranspiration. The collective processes by which water is transferred from the surface of the earth, including from the soil and the surface of water-bodies (through evaporation) and from plants (through transpiration).

Fallon Indian Reservation. The lands set aside for the benefit of the Fallon Paiute-Shoshone Tribes by the orders of the Department of the Interior on April 20, 1907, and November 21, 1917, as expanded and confirmed by the Act of August 4, 1978, Public Law 95-337, 92 Stat. 457.

Fallow. Allowing land that normally is used for crop production to lie idle.

Farm Profits. Sales minus fixed and variable costs.

Flyway. A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging. The act of feeding; another word for feeding.

Forb. An herb that is not a grass or grass-like plant; generally broad-leaved. Wildflowers are forbs.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Service Manual 620 FW 1.5).

Habitat. A place where an animal or plant normally lives and grows.

Habitat Diversity. Refers to the variety in habitat, including the variety of different plant species, lifeforms (e.g., forbs, shrubs, trees), distribution over the landscape, and vertical and horizontal complexity.

Headgate. The control works or gate at the entrance to a canal or conduit system.

Headgate entitlement. The amount of water/acre-feet/year to which a particular water right is entitled.

Hemi-marsh. A 50/50 interspersion of emergent vegetation and open water.

Herb. A non-woody plant; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

Herbivore. A plant-eating animal; includes grazers (animals that eat grasses and forbs), browsers (animals that eat leaves and twigs of shrubs and trees), and animals that do both.

Human Disturbance. See disturbance.

Hydrology. The distribution and cycling of water in an are; or the science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.

Impact. See effect.

Indirect Effects. Physical, biological, social, and economic consequences that occur after or away from the management action that caused the effect.

Inholding. Non-Federal land with a national wildlife refuge.

Indigenous. Native to the area.

Integrated Pest Management. (IMP) Is the control of pests using a particular, economical, and scientifically-based combination of biological, physical, cultural, and chemical control methods. It is a balanced approach which considers hazard to the environment, efficacy, costs, and vulnerability of the pest.

Introduction. The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.

Invasive Species. A nonnative, or alien, species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Invertebrate. Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Irrigation Delivery. Refers to the delivery of water for irrigation purposes.

Irrigation Drainwater. Ideally, subsurface water which flows from irrigated land and generally transports higher concentrations of dissolved salts than the water applied to the land; practically, any water which flows from the Newlands Project for which there is no claim to satisfy an agricultural water right.

Irrigation Return Flow. Water which reaches surface drainage by overland flow or through groundwater discharge as a result of applied or natural irrigation.

Irrigation Season. The period when irrigation water is delivered for agricultural purposes; on the Newlands Project this is traditionally March 15 to November 15, subject to weather conditions and water supply.

Issue. Any unsettled matter that requires a management decision; e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (Service Manual 602 FW 1.5).

Lacustrine. Of or pertaining to lakes. More specifically, this term refers to permanent, seasonal, and intermittent lakes and reservoirs that typically have depths exceeding 6 feet and are larger than 20 acres, and that have less than 30 percent of their area covered by emergent wetlands vegetation.

Lahontan Valley Wetlands. Generally refers to the wetland ecosystem in the Lahontan Valley. As designated in Public Law 101-618, Lahontan Valley wetland areas specifically refer to the wetlands associated with Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture, and Fallon Indian Reservation.

Landowner. A person or entity indicated as the owner of property on the various ownership maps maintained by the Office of the County Assessor.

Lease. A legal contract by which water rights are acquired for a specified period of time for a specified rent or compensation.

Lower Truckee River. The Truckee River downstream from Derby Dam.

Management Alternative. See Alternative.

Marsh. A periodically wet or continually flooded area where the water is shallow enough to allow the growth of emergent vegetation such as sedges, rushes, and cattails.

Marsh Habitat. Habitat that is characterized by shallow water and emergent vegetation. Unless otherwise specified, this term does not apply to similar habitat found in rivers, drains, or canals.

Migratory Bird. A bird that seasonally moves between geographic areas. In reference to birds in the Great Basin, a bird that breeds in Great Basin and subsequently moves south of the Great Basin for the winter months. Birds that migrate south of Mexico for the winter are considered neotropical migrants.

Middle Carson River. The Carson River corridor upstream of Lahontan Reservoir to the Dayton area. Does not include any portion of Carson Division of the Newlands Project.

Mission Statement. Succinct statement of the unit's purpose and reason for being.

Mitigation. To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Mobilization. Transport or movement of an element or other substance into the water column.

Model. A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Multiplier. A number by which another number is multiplied. Used in economic analysis to show linkages.

National Environmental Policy Act (NEPA). An act that encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality (CEQ). The act requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

National Wildlife Refuge (Refuge or NWR). A designated area of land or water or an interest in land or water within the system, including national wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas (except coordination areas) under Service jurisdiction for the protection and conservation of fish and wildlife. A complete listing of all units of the Refuge System may be found in the current "Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service."

National Wildlife Refuge System, Refuge System, or System. Various categories of areas that are administered by the Secretary for the conservation of fish and wildlife, including species that are threatened with extinction; all lands, waters, and interest therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management or waterfowl production areas.

National Wildlife Refuge System Mission. The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Native Species. A species that occurs naturally in an area; not introduced by humans either accidentally or intentionally.

Natural Ecological Conditions. The set of biotic and environmental conditions that were created and maintained in a particular area through geological, evolutionary, and other ecological processes apart from human influence.

Neotropical Migrant. In reference to birds occurring on the Stillwater NWR Complex, it is a bird whose winter distribution occurs wholly or partly south of the United States and whose distribution during the breeding season or migration includes the Stillwater NWR Complex.

Newlands Irrigation Project. A project, initiated with passage of the Reclamation Act in 1902, that was designed to irrigate land near Fallon, Nevada. The Bureau of Reclamation was given jurisdiction over public lands to construct and operate the project.

Newlands Project Efficiency. The ratio of irrigation delivery demand to Lahontan Reservoir releases, excluding spills.

No Action Alternative. An alternative under which existing management would be continued.

Nonnative Species. Any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to a particular area or ecosystem.

Non-Priority Public Use. Any use of a refuge other than a compatible wildlife-dependent recreational use.

Objective. An objective is a concise statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies, monitoring refuge accomplishments, and evaluating the success of the strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Service Manual 602 FW 1.5).

Operation and Maintenance (O&M) Costs. Charges paid by water users for delivery of water in the Newlands Project that are paid to the Newlands Project operator for reasonable and customary operation and maintenance of the delivery system.

Operating Criteria and Procedures (OCAP) - A set of criteria and procedures established by the Department of the Interior for the Newlands Project.

Palustrine. Of or pertaining to marshes or marsh habitat. More specifically, for this document, this term refers to permanently, seasonally, and intermittently flooded areas that typically have depths less than six feet and that have more than 30 percent of their area covered by emergent wetland vegetation.

Passerine Bird. A songbird or other perching bird that is in the order Passeriformes. Blackbirds, crows, warblers, sparrows, and wrens for example.

Perennial. In reference to a body of water, one that contains water year-to-year and that rarely goes dry.

Peak Flow. The maximum discharge of a stream during a specified period of time.

Physical Control. With respect to controlling undesirable species, the reduction of pest populations through means other than chemical, cultural, or biological controls. It includes, but is not limited, to shooting, trapping, fencing, and use of sonic devices.

Plant Community. An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Playa. A shallow basin where water collects and evaporates.

Pollutant. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

Preferred Alternative. The alternative that is preferred by the Service prior to an alternative being selected for implementation.

Prescribed Fire. The application of fire to wildland fuels to achieve identified land use objectives (Service Manual 621 FW 1.7). May be from natural ignition or intentional ignition.

Primary Wetlands. Wetlands (see definition of wetland) located within Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture, and the Fallon Indian Reservation (i.e., the Lahontan Valley wetlands designated by Public Law 101-618).

Primary Wetland-Habitat. Habitat provided by shallow or deep water (up to 6-feet deep), with or without emergent and aquatic vegetation in the designated Lahontan Valley wetlands at Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture, and the Fallon Indian Reservation. Primary wetland habitat only exists when and where a primary wetland or portion of a primary wetland is flooded with water (visible surface water). Consequently, the size and shape of "primary wetland habitat" will fluctuate from season-to-season and year-to-year while the size and shape of the "primary wetland" within which primary wetland habitat occurs will remain constant from season to season and from year to year. Primary wetlands only provide habitat for waterfowl, shorebirds, muskrats, aquatic insects, and other wetland-dependent wildlife when they contain surface water (i.e., when they provide wetland habitat).

Prime Water. Ideally, Newlands Project irrigation water released from storage for delivery to a head gate; practically, any water delivered via a canal to a head gate.

Priority Public Uses. Activities involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation when they are compatible with refuge purpose and the mission of the Refuge System.

Proposed Action. The Service's proposed action for the CCP and boundary revision is to prepare and implement a CCP for Stillwater NWR Complex and to delineate and propose a boundary revision for Stillwater NWR.

Public. Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Public Involvement. A process that offers interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Scoping. See public involvement.

Public Uses. Activities conducted by the general public on a national wildlife refuge.

Purposes of the Refuge. The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge sub-unit.

Raptor. A bird of prey, such as a hawk, eagle, or owl.

Recommended Wilderness. Areas studied and found suitable for wilderness designation by both the Director and Secretary, and recommended for designation by the President to Congress. These areas await only legislative action by Congress in order to become part of the Wilderness System. Such areas are also referred to as "pending in Congress" (Service Manual 610 FW 1.5).

Record of Decision (ROD). A concise public record of decision prepared by a Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

Recoupment. Recovery or repayment of water that was diverted from the Truckee River to the Newlands Project in excess of amounts permitted by OCAP during the period between March 1973 and December 1987.

Refuge Goal. See goal.

Refuge Operating Needs System (RONS). The Refuge Operating Needs System is a national database which contains the unfunded operational needs of each refuge. Projects included are those required to implement approved plans, and meet goals, objectives, and legal mandates.

Refuge Purposes. The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, a refuge unit, or refuge subunit (Service Manual 602 FW 1.5).

Remediation. The act or process of correcting a problem.

Reservoir. An artificially created basin, one part of which is usually a dike or dam, in which water is collected and stored for future use.

Reservoir Storage. The volume of water held in a reservoir at any particular time.

Return Flow. See irrigation return flow.

Riparian Area. The land adjacent to rivers, streams, and irrigation canals and drain ditches where vegetation is influenced by higher amounts of water than the surrounding lands. For the purpose of this EIS, riparian areas do not include the land surrounding lakes and basin marshes.

Riverine. A wetland comprised of a river.

Salinity. An expression of the amount of dissolved solids in water.

Sanctuary. A protected area in which wildlife can feed, rest, and breed undisturbed by people and human activities.

Secondary Wetlands. Wetland habitat in the EIS study area that are not associated with Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture, and the Fallon Indian Reservation. These areas are not part of the primary wetlands mandated to be sustained by Public Law 101-618. The term "secondary" denotes location; it does not identify the relative importance to wetland-dependent wildlife.

Sediment. Any material, carried in suspension by water, which ultimately settles to the bottom of water courses. Sediments may also settle on stream banks or flood plains during high water flow.

Shorebirds. Long-legged birds, also known as waders, belonging to the Order Charadriiformes that use shallow wetlands and mud flats for foraging and nesting.

Soil Erosion. The wearing away of the land's surface by water, wind, ice, or other physical process.

Species. A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification. Examples include the American robin, mule deer, Fremont cottonwood, broadleaf cattail, and southern cattail.

Spill. With reference to a reservoir operations, water that is released, either inadvertently or through precautionary releases, in excess of that required to compensate for delivery system losses and to meet irrigation demand.

Spillway. The overflow channel of a dam.

Spoil Piles. Piles of soils formed during the process of cleaning out canals and drains. Accumulated sediments in the canals and drains are removed and disposed along their banks.

Step-down Management Plans. Step-down management plans deal with specific management subjects (e.g., habitat, public use, safety) or groups of related subjects. Step-down management plans describe management strategies and implementation schedules.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.5).

Stocking. The act of periodically reintroducing fish or other wildlife into suitable habitat for the purpose of providing fishing and hunting opportunities for the public.

Submergent Vegetation. Plants that grow completely submerged except when flowering.

Sub-surface Drainage. Irrigation water that percolated into the soil and subsequently flows under the surface of irrigated farmland into drains.

Surface Water. A body of water that has its upper surface exposed to the atmosphere.

Terminus. In reference to a stream or river, its end point; where it flows into a lake or other basin.

Threatened Species. Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and one that has been designated as a threatened species in the Federal Register by the Secretary of the Interior. Threatened species are afforded protection under the Endangered Species Act of 1973.

Tiering. The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues (40 CFR 1508.28).

Total Dissolved-Solids (TDS). The total concentration of solids (or salts) dissolved in water; specific conductance is a surrogate measure of dissolved solids. More specifically, total

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dissolved-solids is an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts.

Trace Elements. Metallic elements (with atomic number >21) generally occurring in trace amounts in water, including iron, manganese, copper, chromium, arsenic, mercury, and vanadium.

Transfer Rate. The use rate for a water right that is transferred from an owner to a buyer during a transaction.

Transient Species. Animals that migrate through a locality without breeding or overwintering.

Tripartite Agreement. The 50-year agreement between the Truckee-Carson Irrigation District, the Nevada State Board of Fish and Game Commissioners, and the U.S. Fish and Wildlife Service regarding the establishment, development, operation, and maintenance of Stillwater National Wildlife Refuge and Management Area, dated November 26, 1948.

Truckee Division. The Truckee Division of the Newlands Project is located near Fernley, Nevada contains about 6,000 acres of water-righted land, and relies on water from the Truckee River.

Truckee-Carson Irrigation District (TCID). The current contract operator of the Newlands Irrigation Project.

Truckee River Operating Agreement. The agreement to be negotiated between the Secretary of the Interior and the States of California and Nevada and others for the operation of Truckee River reservoirs.

Truckee River Basin. The area which naturally drains into the Truckee River and its tributaries and into Pyramid Lake, including that lake, but excluding the Lake Tahoe basin.

Unconsolidated. A geological term that describes soil that is not compacted.

Upland. An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

Use-rate. The amount of water/AF/year to which a particular water right is entitled.

Vegetation Community. See plant community.

Vertebrate. An animal having a segmented backbone or vertebral column; includes mammals, birds, fish, amphibians, and reptiles.

Vision Statement. A concise statement of the desired future condition of the planning unit. based primarily upon the System mission, specific refuge purposes, and other relevant mandates (Service Manual 602 FW 1.5).

Water Duty. The maximum rate at which water can legally be delivered to a farm head gate to satisfy a water right, usually expressed in acre-feet/acre/year.

Water Year. That period of time between October 1 of one calendar year and September 30 of the next calendar year. Traditionally, hydrologic data (i.e., stream flows, precipitation, etc.) was summarized or totaled for this period of time.

Waterfowl. A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Water-righted Acreage. The land base for which there are water rights.

Water Rights. A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date of use, called priority, or prior appropriation.

Watershed. The entire land area that collects and drains water into a river or river system.

Wetland. Land that is transitional between upland (terrestrial) and aquatic systems (greater than about 6-feet deep) where the water table is usually at or near the surface or the land is covered by shallow water... wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (plants that require wet conditions); (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin et al., 1979).

Wetland-Dependant Wildlife. Wildlife that is dependent on wetlands, including riparian and riverine habitats, for their existence.

Wetland-Habitat. Habitat provided by shallow or deep water (but less than 6-feet deep), with or without emergent and aquatic vegetation in wetlands. Wetland habitat only exists when and where a wetland or portion of a wetland is covered with water (visible surface water). Consequently, the size and shape of "wetland habitat" will fluctuate from season-to-season and year-to-year while the size and shape of the "wetland" within which wetland habitat occurs will remain constant from season to season and from year to year. Wetlands only provide habitat for waterfowl, shorebirds, muskrats, aquatic insects, and other wetland-dependent wildlife when they contain surface water (i.e., when they provide wetland habitat).

Wilderness Study Areas. Lands and waters identified through inventory as meeting the definition of wilderness and undergoing evaluation for recommendation for inclusion in the Wilderness System. A study area must meet the following criteria: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 contiguous roadless acres or is sufficient in size as to make practicable its preservation and use in an unimpaired condition (Service Manual 610 FW 1.5).

Wilderness. See designated wilderness.

Wildfire. A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

Wildland fire. Every wildland fire is either a wildfire or a prescribed fire (Service Manual 621 FW 1.3)

Wildlife. All non-domesticated animal life; includes all species of vertebrates and invertebrates.

Wildlife-Dependant Recreation. A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation. These are the six priority general public uses of the Refuge System as established in the Refuge System Administration Act, as amended.

Wildlife Diversity. Refers to the identity and number of species (e.g., species list) and the relative abundance of each species.

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